628.16
Il6ii
1971

State of Illinois
The Environmental Protection Agency

LAKE MICHIGAN OPEN WATER AND LAKE BED SURVEY 1971

AUG. 26th 1818

THE LIBRARY OF THE
AUG 2 1973
UNIVERSITY OF ILLINOIS
AT URBANA-CHAMPAIGN

ISL

Digitized by the Internet Archive
in 2013

http://archive.org/details/lakemichiganopen1971illi

ILLINOIS ENVIRONMENTAL PROTECTION AGENCY

2200 Churchill Road Springfield, Illinois 62706

Mary Lee Leahy, Director

The Honorable Daniel Walker
Governor, State of Illinois

Honorable Members of the 77th
General Assembly, State of Illinois

Gentlemen:

This report presents the results of the 1971 Lake Michigan Open Water and Lake Bed surveys conducted by the Environmental Protection Agency.

These surveys were authorized initially by the 75th General Assembly to evaluate the ecology and quality of the open water of Lake Michigan. Responsibility for these surveys, originally vested in the Sanitary Water Board, is assigned to the Environmental Protection Agency under provisions of the Environmental Protection Act.

Twenty water quality parameters were monitored routinely during the year; of these, 15% exceeded the applicable water quality standard. In addition, lake bed sampling indicated that slightly more than half of the established stations sampled were "biologically degraded."

The monitoring of pesticides, mercury and other heavy metals was expanded in 1971 and included the collection and analyses of Lake Michigan fish, water and sediments for the presence of chlorinated hydrocarbon pesticides and heavy metals. Also, with advances in laboratory techniques, analyses were performed for the presence of polychlorinated biphenyls and phthalates which were previously undetected in Lake Michigan and which have potentially significant environmental impact.

The 1970 mercury "scare" and the discovery of polychlorinated biphenyls and phthalates in Lake Michigan serve as uncomfortable reminders that the aquatic environment is still inadequately understood. It is clear that the State of Illinois must maintain a continuing program of surveillance and monitoring to, (1) determine the concentrations of aquatic contaminants for their impact on the aquatic ecosystem and on public health, (2) adequately evaluate changes in lake environments which may affect the economic and aesthetic values of Lake Michigan and, (3) assess the effectiveness of measures taken by Illinois and other lake states to control or eliminate the pollution of Lake Michigan.

Sincerely,

Mary Lee Leahy

Mary Lee Leahy
Director

MLL:JJF:jah

LAKE MICHIGAN WATER QUALITY EVALUATION, 1970 - 1971

Based on data collected by the Environmental Protection Agency in 1970 and 1971 the following comparisons are made:

COLIFORM AND FECAL STREPTOCOCCI - bacterial densities were within the standards during 1970-1971. For both parameters, lake bacterial densities increased during this period.

FECAL COLIFORM - bacterial densities were within the standard in 1970-1971. A substantial increase in quality was noted in 1971.

ODOR, OIL, FLOATING SOLIDS AND DEBRIS - were within the standards in 1970-1971. No significant changes occurred during this period.

TEMPERATURE AND pH - values were within the standards in 1970-1971. Little significant changes occurred in this period.

CYANIDE, FLUORIDE, PHENOLS AND RADIOACTIVITY - levels were within the standards in 1970-1971. No significant change occurred during this period.

PHOSPHATES - 1971 data is based on filtered samples and is not comparable to 1970 data on unfiltered samples.

SULFATES AND FILTRABLE RESIDUE - levels were within the standards in 1970-1971. Concentrations increased slightly during this period.

DISSOLVED OXYGEN - concentrations, while within the standards, decreased slightly from 1970 to 1971.

TURBIDITY - levels, while generally considered to be within the standards in 1970-1971, increased during this period.

MBAS AND CHLORIDES - levels exceeded standards in 1970-1971 and continued to show upward trend during this period.

AMMONIA - levels exceeded the standard in 1971 and showed a generalized upward trend in both the shore and open waters.

TABLE OF CONTENTS

PAGE

List of Tables ii
List of Figures iii
Abstract iv
Water Monitoring Program 1
   General information 1
      Open Water 1
      U.S. Established Dump Area 3
      Calumet Harbor 3
   Factors influencing Water Quality 3
   Open Water Monitoring 4
      Water Plants 4
      Boat Sampling 21
         4-mile Lake Stations 21
         U.S. Established Dump Area 34
         Calumet Harbor 38
Lake Bed Survey 45
   General information 45
   Results and Evaluation 45
      Established Stations 45
      Special Stations 45
         Commonwealth Edison, Zion 51
         Great Lakes Naval Training Center Harbor 52
         U.S. Steel, Waukegan 54
         Lincoln Park Gun Club, Chicago 55
         Burnham Park Harbor, Chicago 56
         Jackson Park Outer Harbor, Chicago 57
         Calumet Harbor Breakwater, Chicago 58
Phytoplankton Sampling 59
   General Information 59
   Results 59
Special Sampling 63
   General Information 63
      Pesticides 63
      Polychlorinated Biphenyls 63
      Phthalates 63
      Heavy Metals 64
   Results of Monitoring 64
      Pesticides, PCB's and Phthalates in Water 64
      Pesticides, PCB's and Phthalates in Sediments . . . 64
      Pesticides, PCB's and Phthalates in Fish 64
      Heavy Metals in Water 65
      Heavy Metals in Sediments 65
      Heavy Metals in Fish 65
Lake Michigan Enforcement Conferences 77
Legislative and Regulatory Action 77
Sewage Treatment Plants Discharging into Lake Michigan . . . 81
Illinois Industries Discharging into Lake Michigan 83
Metropolitan Sanitary District of Greater Chicago 84

LIST OF TABLES

TABLE NUMBER PAGE

Water Quality Parameters - Open Water

Water Filtration Plant Sampling

1 WFP Sampled in 1971 . . . 2
2 Coliform Bacteria . . . 4
3 Fecal Streptococci . . . 5
4 Turbidity . . . 6
5 pH . . . 8
6 Ammonia . . . 9
7 MBAS . . . 10
8 Chloride . . . 11
9 Fluoride . . . 12
10 Dissolved Iron . . . 13
11 Sulfate . . . 14
12 Phosphate . . . 15
13 Filtrable Residue . . . 16
14 Alpha and Beta Radioactivity . . . 17
15 Fecal Coliform . . . 18
16 Plankton . . . 19

Boat Sampling

17 Coliform Bacteria . . . 21
18 Fecal Streptococci . . . 22
19 pH . . . 24
20 Dissolved Oxygen . . . 25
21 Ammonia . . . 26
22 MBAS . . . 27
23 Chloride . . . 28
24 Sulfate . . . 29
25 Phosphates . . . 30
26 Filtrable Residue . . . 31
27 Fecal Coliform . . . 32
28 Plankton . . . 32
29 Secchi Disc . . . 33
30 Water Quality at U.S. Dump Area . . . 37

Lake Bed Survey

Benthos Sampling

31 Zion to Evanston (Stations 1-36) . . . 46
32 Chicago (Stations 37-65; A-J) . . . 48
33 Commonwealth Edison, Zion (Stations 1-12) . . . 51
34 Great Lakes Naval Training Center (Stations 1-13) . . . 52
35 U.S. Steel, Waukegan (Stations 1-16) . . . 54

TABLE NUMBER PAGE

36 Lincoln Park Gun Club (Stations 1-5) 55
37 Burnham Harbor (Stations 1-3) 56
38 Jackson Park Outer Harbor (Stations 1-4) 57
39 Calumet Harbor (Stations 1-6) 58

Phytoplankton Sampling

40 Phytoplankton genera collected in Lake Michigan 60
41 Pollutional classification for Phytoplankton 61

Special Sampling

42 Pesticides, PCB's and Phthalates in Water 67
43 Pesticides, PCB's and Phthalates in Sediments 68
44 Pesticides, PCB's and Phthalates in Fish 70
45 Heavy metals in water 72
46 Selenium in water 73
47 Lead, Mercury and Selenium in Sediments 74
48 Lead, Mercury and Selenium in Fish 75

LIST OF FIGURES

FIGURE NUMBER PAGE

1 Locations of Lake Bed Stations offshore from Zion to Evanston 47
2 Locations of Lake Bed Stations offshore from Chicago 49
3 Commonwealth Edison Nuclear Plant, Zion 51
4 Locations of Lake Bed Stations in GLNTC Harbor and Adjacent Waters 53
5 United States Steel Plant, Waukegan 54
6 Lincoln Park Gun Club, Chicago 55
7 Burnham Park Harbor, Chicago 56
8 Jackson Park Outer Harbor, Chicago 57
9 Calumet Harbor Breakwater, Chicago 58

ABSTRACT

OPEN WATER AND LAKE BED SURVEYS

Open water samples were collected for water quality determination at the raw water intakes of twelve municipal water filtration plants on a twice per month schedule in 1971. Additional samples were collected by boat at eight stations located 4 miles offshore. Bottom dredge samples were obtained at 63 established lake bed stations and 69 special stations.

Results of the biological, chemical and microbiological analyses were compared to the Water Quality Standards, SWB-7, and subsequent Pollution Control Board revisions.

Twenty water quality parameters were monitored routinely; the results are summarized below.

In compliance with standards

- Coliform Bacteria
- Fecal Steptococci
- Turbidity
- Odor
- Oil
- Floating Solids and Debris
- Temperature
- pH
- Dissolved Oxygen
- Cyanides
- Fluorides
- Dissolved Iron
- Phenols
- Sulfates
- Phosphates
- Filtrable Residue
- Radioactivity

Not in compliance with standards

- Ammonia
- Chlorides
- Methylene Blue Active Substance

Results from water plant and boat sampling differed only in pH and chloride levels with median pH values being slightly higher at the boat stations and chlorides being somewhat higher at the water plants.

Lake bed sampling indicated that slightly more than half of the established stations sampled were "biologically degraded".

SPECIAL SAMPLING

The monitoring of pesticides, mercury and heavy metals was expanded in 1971 and included the collection and analysis of Lake Michigan fish, water and sediments for the presence of chlorinated hydrocarbon pesticides, polychorinated biphenyls, phthalates and heavy metals.

DDT levels in fish averaged 1.4 parts per million, which exceeded the limit of 1.0 ppm recommended by the Pesticides Committee of the Lake Michigan Enforcement Conference. However, this was below the 5.0 ppm "action level" for DDT established by the U.S. Food and Drug Administration.

Mercury and PCB levels in fish, and heavy metals in water were within guideline limits.

WATER MONITORING PROGRAM

GENERAL INFORMATION

Water quality data were obtained from three areas of Lake Michigan: (1) Open Water, (2) U.S. Established Dump Area and (3) Calumet Harbor. Descriptions of the areas and the sampling program are presented in the following sections.

Water Quality Standards for Lake Michigan, Rules and Regulations SWB-7, adopted by the Illinois Sanitary Water Board, served as the basis for evaluation of 1971 monitoring results in the Open Water and U.S. Established Dump Area. Rules and Regulations SWB-15 are applicable to the waters of Calumet Harbor. In 1971, the Pollution Control Board revised these standards with respect to three parameters: temperature, phosphorus and mercury (with the passage of the Environmental Protection Act in 1970, the Sanitary Water Board was phased out and all standard-setting responsibilities were transferred to the Pollution Control Board).

Lake bed and water samples were collected by surveillance personnel in the Agency's Division of Water Pollution Control. All analyses were performed by personnel of the Agency's Chicago Laboratory. The Division of Waterways, Illinois Department of Transportation (formerly Public Works and Buildings), provided a boat for the Agency's lake bed and offshore water quality sampling.

OPEN WATER

The raw water intakes at the municipal water filtration plants which utilize Lake Michigan as their source of water supply have been designated in SWB-7 as the control points for monitoring the quality of the open waters.

Twelve water plants were included in the 1971 monitoring program: Zion-Benton, Waukegan, North Chicago, Lake Forest, Highland Park, Glencoe, Winnetka, Kenilworth, Wilmette, Evanston, Chicago Central and Chicago South. Two of the plants, Zion-Benton and Chicago Central, are new additions to the monitoring program and provide additional input to the water quality data bank. Zion-Benton became operational in late 1970 and was incorporated into the Agency's sampling program in the summer of 1971. Also, in late 1970, the crib intake line at the Chicago Central plant was completed and Agency sampling at this facility began in January of 1971. Raw water samples were collected twice per month throughout 1971 with the exception of the Zion-Benton plant as noted above. Information on intake locations at these plants is presented in Table 1.

In addition to the water plant sampling program, water samples were collected by boat in the open waters of the lake. During the year, eight such boat sampling cruises were conducted. These samples were collected 4 miles offshore from the following eight locations: Wisconsin-Illinois State Line, Zion, Waukegan, Highland Park, Winnetka, Evanston and the Chicago Central water plant and Chicago South water plant.

TABLE 1. WATER FILTRATION PLANTS SAMPLED IN 1971

Name of Plant	Number of Intakes	Distance of Intake from Shore (ft.)	Depth drawn from (ft.)
Zion-Benton	1	2,700	37
Waukegan	2	Shore	5
		6,200	35
North Chicago	1	6,500	28
Lake Forest	2	3,900	24
		6,500	30
Highland Park	3	1,000	9
		2,000	20
		3,500	28
Glencoe	2	2,000	25
		3,300	18
Winnetka	2	1,200	20
		3,000	15
Kenilworth	1	2,100	20
Wilmette	1	3,300	21
Evanston	3	1,800	16
		2,600	18
		5,600	28
Chicago Central	2	Shore	20
		13,000	35
Chicago South	2	Shore	24
		12,100	32

U.S. ESTABLISHED DUMP AREA

An area at the southern end of Lake Michigan has been designated by the Federal government as a site for the dumping of non-pollutional harbor dredgings and other materials. This area, located approximately 10 miles east of the Illinois shore between the lakeward extensions of Montrose Avenue and Calumet Harbor, is shown in Figure 2. Senate Bill 1794, passed by the 75th General Assembly in 1967, prohibits the issuance of permits by the Illinois Department of Transportation (formerly the Dept. of Public Works and Buildings) for the deposition of rock, earth, sand or other material or any refuse matter of any kind or description in Lake Michigan without the concurrence of the Environmental Protection Agency.

One water sampling cruise was made to the Dump Area in October 1971 to collect samples for water quality determination.

CALUMET HARBOR

Water samples were collected within Calumet Harbor during three samplings cruises in August, September and October 1971. These samples were collected at two stations, located at (X) the Illinois-Indiana State Line and at (Y) the mouth of the Calumet River (Figure 9).

FACTORS INFLUENCING WATER QUALITY

Discharges from Indiana and Illinois industries along the southwestern shore of the lake affect the quality of Illinois waters. Inadequately treated effluents discharged into the lake from sewage treatment facilities contribute to the lake's organic enrichment (Illinois industries and municipalities with lake discharges are discussed in the latter portions of this report).

In addition to man-made inputs to Lake Michigan, lake water quality is also affected by naturally occurring phenomena. During most of the year, from about April to November, the lake is thermally stratified due to density differences between the warmer surface waters and the colder deep water layers. Stratification is destroyed during the late fall and spring overturns. During these periods, when mixing occurs between the surface and bottom waters, turbidity becomes more apparent and there is an increase in the mineral content of the open waters.

Lake currents affect the dispersal pattern of effluents through physical transport which may carry effluents a considerable distance from the point of discharge.

Storm water runoff is another factor which influences lake water quality. Increases in bacteria counts, suspended and dissolved solids, and organic and nutrient levels can be expected following a storm. Also, the visible floatage associated with storm water runoff is aesthetically objectionable.

OPEN WATER MONITORING - WATER PLANTS

RESULTS AND EVALUATION

COLIFORM BACTERIA (Indicators of contamination, usually by sewage or storm runoff)

Standards:
Annual Average (Arithmetic) - not more than 200 per 100 ml
Single Daily Value or Average - not more than 2,500 per 100 ml

Coliform bacteria counts were within the standards at all twelve water filtration plants in 1971.

Annual average counts ranged from 11/100 ml at Waukegan to 104/100 ml at Highland Park. The highest single count recorded in 1971 was 1,100/100 ml, which was recorded at Highland Park.

TABLE 2. COLIFORM BACTERIA COUNTS IN LAKE MICHIGAN OPEN WATER, 1971

(Expressed as numbers per 100 milliliters)

WATER FILTRATION PLANT	MINIMUM	MAXIMUM	ANNUAL AVERAGE
Zion - Benton	1	140	34
Waukegan	1	70	11
North Chicago	1	750	47
Lake Forest	1	850	74
Highland Park	1	1,100	104
Glencoe	1	100	32
Winnetka	1	240	51
Kenilworth	1	230	54
Wilmette	1	190	40
Evanston	1	80	26
Chicago Central	1	110	18
Chicago South	1	100	23
SWB-7 Limits: Not more than		2,500	200

FECAL STREPTOCOCCI (Bacterial indicators of recent contamination by sewage)

Standard: Not more than 25 per 100 ml

Fecal streptococci counts were in general compliance with the standard in 1971.

During 1971, nine samples from six water filtration plants exceeded the standard. These values ranged from 34/100 ml at Waukegan to 300/100 ml at Lake Forest. However, these samples represented less than 4% of the total samples analyzed.

TABLE 3. FECAL STREPTOCOCCI COUNTS IN LAKE MICHIGAN OPEN WATER, 1971

(Expressed as numbers per 100 milliliters)

WATER FILTRATION PLANT	MINIMUM	MAXIMUM	ANNUAL AVERAGE
Zion - Benton	1	4	1
Waukegan	1	34	3
North Chicago	1	150	9
Lake Forest	1	300	18
Highland Park	1	42	5
Glencoe	1	8	2
Winnetka	1	100	9
Kenilworth	1	12	5
Wilmette	1	6	2
Evanston	1	250	15
Chicago Central	1	8	2
Chicago South	1	8	2
SWB-7 Limit: Not more than		25	

TURBIDITY (An indicator of the presence of suspended and colloidal matter)

Standard: No turbidity of other than natural origin that will cause substantial visible contrast with the natural appearance of the water

Since laboratory procedures for turbidity are reported as numerical values which are not directly compatible with the turbidity standard, the recommendation of the National Technical Advisory Committee to the Secretary of the Interior (Water Quality Criteria, 1968) relative to turbidity has been used as a guideline for evaluation purposes in this report. The Committee recommended that "The turbidity of cold-water or oligotrophic lakes should not exceed 10 units." Lake Michigan is considered to be a cold-water or oligotrophic lake.

Evaluated on the basis of the above guideline value, turbidity levels were in general compliance in 1971.

However, it should be noted that 38% of the samples analyzed for turbidity exceeded the recommended limit of 10 JTU. The maximum values at all twelve water filtration plants exceeded 10 JTU. These maximum values ranged from 15 JTU at Zion-Benton to 72 JTU at Highland Park. On an annual average basis only the Zion-Benton and the two Chicago water plants were within the guideline limit.

TABLE 4. TURBIDITY LEVELS IN LAKE MICHIGAN OPEN WATER, 1971

(Jackson Turbidity Units)

WATER FILTRATION PLANT	MINIMUM	MAXIMUM	ANNUAL AVERAGE
Zion-Benton	3	15	7
Waukegan	3	59	14
North Chicago	3	48	15
Lake Forest	3	48	17
Highland Park	5	72	16
Glencoe	3	37	13
Winnetka	3	52	16
Kenilworth	3	59	15
Wilmette	3	48	14
Evanston	3	40	13
Chicago Central	3	22	9
Chicago South	1	22	7
Water Quality Criteria limit		10	

ODOR

Standard: No obnoxious odor of other than natural origin

There were no significant odors in the raw water samples collected from the water filtration plants in 1971.

OIL

Standard: Substantially free of visible floating oil

Raw water samples collected in 1971 were free from oil contamination.

FLOATING SOLIDS AND DEBRIS

Standard: Substantially free of floating solids and debris from other than natural sources

Floating solids and debris were not observed in raw water samples collected from the water filtration plants in 1971.

TEMPERATURE

Standard: The water temperature shall not exceed the maximum limits (°F) indicated in the following table:

JAN.	FEB.	MAR.	APR.	MAY	JUN.	JUL.	AUG.	SEPT.	OCT.	NOV.	DEC.
45	45	45	55	60	70	80	80	80	65	60	50

In June of 1971, the Pollution Control Board adopted new thermal standards for Lake Michigan (PCB R70-2) which superceded the former SWB-7 standard of 85°F. For the purposes of this report, all of the 1971 temperature data have been evaluated on the basis of the revised PCB standards.

Lake Michigan open water temperatures were within the standards in 1971.

The maximum temperature recorded at the Highland Park water filtration plant for March (51°F) exceeded that month's standard, and the Chicago Central and South plants exceeded the temperature standard for October (66 and 68°F, respectively). These higher temperatures constituted approximately 1.2% of the total temperature measurements recorded in 1971.

pH - HYDROGEN ION CONCENTRATION

(Indicates whether water is acid, neutral or alkaline)

Standard:	Annual Median - within range 8.1 - 8.4
	Daily Median - within range 7.7 - 9.0

The pH levels in the open water were within the standards in 1971.

Daily values ranged from 7.8 to 8.8. Annual median values ranged from 8.2 to 8.4.

TABLE 5. pH LEVELS IN LAKE MICHIGAN OPEN WATER, 1971

(pH Units)

WATER FILTRATION PLANT	MINIMUM	MAXIMUM	ANNUAL MEDIAN
Zion-Benton	8.0	8.5	8.2
Waukegan	7.8	8.5	8.3
North Chicago	7.9	8.7	8.4
Lake Forest	7.9	8.7	8.3
Highland Park	8.0	8.7	8.3
Glencoe	8.0	8.7	8.3
Winnetka	8.0	8.7	8.3
Kenilworth	8.1	8.7	8.3
Wilmette	8.0	8.7	8.3
Evanston	8.0	8.8	8.3
Chicago Central	7.9	8.6	8.3
Chicago South	7.9	8.6	8.3
SWB-7 Limits:	7.7	9.0	within range 8.1 - 8.4

DISSOLVED OXYGEN

Dissolved oxygen data were not gathered from the water filtration plants (turbulance created in the intake piping system induces artificial aeration which is not representative of actual lake conditions). See Table 20 on page 25 for dissolved oxygen data from open water.

AMMONIA (A decomposition product of organic matter; an indicator of recent sewage contamination)

Standards: Annual Average - 0.02 mg/l (as NH_3)
Single Daily Value or Average - 0.06 mg/l (as NH_3)

Ammonia values exceeded the annual average standard in 1971.

Annual average values exceeded the applicable standard at all twelve water filtration plants. These values ranged from 0.04 to 0.08 mg/l. The highest single values recorded at all of the water plants exceeded the standard for single daily values. In all, 32% of the single samples exceeded this standard.

TABLE 6. AMMONIA (NH_3) CONCENTRATIONS IN LAKE MICHIGAN OPEN WATER, 1971

(Milligrams per liter)

WATER FILTRATION PLANT	MINIMUM	MAXIMUM	ANNUAL AVERAGE
Zion-Benton	0.00	0.20	0.07
Waukegan	0.00	0.20	0.05
North Chicago	0.00	0.70	0.06
Lake Forest	0.00	0.60	0.08
Highland Park	0.00	0.10	0.04
Glencoe	0.00	0.15	0.04
Winnetka	0.00	0.20	0.07
Kenilworth	0.00	0.20	0.06
Wilmette	0.00	0.10	0.05
Evanston	0.00	0.20	0.06
Chicago Central	0.00	0.20	0.05
Chicago South	0.00	0.20	0.05
SWB-7 Limits: Not more than		0.06	0.02

METHYLENE BLUE ACTIVE SUBSTANCE (A component of detergents; may be toxic to fish, cause undesirable tastes, and produce unsightly persistent foams)

Standards: Annual Average - not more than 0.05 mg/l
Single Daily Value or Average - not more than 0.20 mg/l

MBAS concentrations exceeded the annual average standard in 1971.

The annual average standard was exceeded at all twelve water filtration plants. These values ranged from 0.10 mg/l at North Chicago to 0.18 mg/l at Zion-Benton. The single daily value was exceeded only once during the year (Zion-Benton). It is interesting to note that while only 0.4% of the samples exceeded the single daily value standard, MBAS concentrations were at levels sufficient to violate the annual average standard.

TABLE 7. MBAS CONCENTRATIONS IN LAKE MICHIGAN OPEN WATER, 1971

(Milligrams per liter)

WATER FILTRATION PLANT	MINIMUM	MAXIMUM	ANNUAL AVERAGE
Zion-Benton	0.10	0.35	0.18
Waukegan	0.00	0.20	0.12
North Chicago	0.00	0.20	0.10
Lake Forest	0.00	0.20	0.11
Highland Park	0.00	0.20	0.11
Glencoe	0.00	0.20	0.11
Winnetka	0.00	0.20	0.11
Kenilworth	0.00	0.20	0.11
Wilmette	0.00	0.20	0.11
Evanston	0.00	0.20	0.11
Chicago Central	0.00	0.20	0.11
Chicago South	0.00	0.20	0.11
SWB-7 Limits: Not more than		0.20	0.05

CHLORIDES (A component of sewage, surface run off and industrial and agricultural wastes)

Standards:
Annual Average - not more than 9 mg/l
Single Daily Value or Average - not more than 15 mg/l

The annual average standard was exceeded in 1971.

Eleven of the twelve water filtration plants exceeded the annual average standard. In addition, the annual average at the twelfth water plant, Zion-Benton, was at the maximum permissible level. While chloride levels were in compliance with the standard for single daily values (only 0.4% of the samples exceeded the standard), the concentrations were sufficient to increase the annual average values to above permissible levels.

TABLE 8. CHLORIDE CONCENTRATIONS IN LAKE MICHIGAN OPEN WATER, 1971

(Milligrams per liter)

WATER FILTRATION PLANT	MINIMUM	MAXIMUM	ANNUAL AVERAGE
Zion-Benton	8	10	9
Waukegan	7	13	10
North Chicago	8	16	10
Lake Forest	7	14	10
Highland Park	8	15	10
Glencoe	8	14	10
Winnetka	8	15	10
Kenilworth	8	13	10
Wilmette	8	14	10
Evanston	8	15	10
Chicago Central	8	12	10
Chicago South	8	15	10
SWB-7 Limits: Not more than		15	9

CYANIDES (Extremely toxic; usually contributed by industrial waste)

Standard: Single Value - not more than 0.025 mg/l

Measurable amounts of cyanides were not recorded in 1971.

FLUORIDES (Normally present in water; abnormal fluctuation generally an indication of a waste discharge)

Standard: Annual Average - not more than 1.0 mg/l
Single Daily Value or Average - not more than 1.3 mg/l

The concentrations of fluorides were within the standards in 1971.

The annual average values at the twelve water filtration plants were uniformly low. Annual averages ranged from 0.1 to 0.2 mg/l. The highest single values ranged from 0.2 to 0.9 mg/l.

TABLE 9. FLUORIDE CONCENTRATIONS IN LAKE MICHIGAN OPEN WATER, 1971

(Milligrams per litter)

WATER FILTRATION PLANT	MINIMUM	MAXIMUM	ANNUAL AVERAGE
Zion-Benton	0.1	0.4	0.2
Waukegan	0.1	0.2	0.1
North Chicago	0.1	0.3	0.1
Lake Forest	0.1	0.5	0.2
Highland Park	0.1	0.2	0.1
Glencoe	0.1	0.2	0.1
Winnetka	0.1	0.4	0.2
Kenilworth	0.1	0.2	0.1
Wilmette	0.1	0.2	0.1
Evanston	0.1	0.2	0.1
Chicago Central	0.1	0.2	0.1
Chicago South	0.1	0.9	0.2
SWB-7 Limits: Not more than		1.3	1.0

DISSOLVED IRON (Usually an industrial waste product when present in significant amounts)

Standards: Annual Average - not more than 0.15 mg/l
Single Daily Value or Average - not more than 0.30 mg/l

The concentrations of dissolved iron were in compliance with the standards in 1971.

Annual average values ranged from 0.01 to 0.03 mg/l. Maximum single values ranged from 0.05 to 0.20 mg/l.

TABLE 10. DISSOLVED IRON CONCENTRATIONS IN LAKE MICHIGAN OPEN WATER, 1971

(Milligrams per liter)

WATER FILTRATION PLANT	MINIMUM	MAXIMUM	ANNUAL AVERAGE
Zion-Benton	0.00	0.05	0.02
Waukegan	0.00	0.10	0.03
North Chicago	0.00	0.10	0.01
Lake Forest	0.00	0.10	0.03
Highland Park	0.00	0.10	0.02
Glencoe	0.00	0.20	0.03
Winnetka	0.00	0.10	0.02
Kenilworth	0.00	0.20	0.02
Wilmette	0.00	0.20	0.02
Evanston	0.00	0.20	0.03
Chicago Central	0.00	0.07	0.02
Chicago South	0.00	0.05	0.01
SWB-7 Limits: Not more than		0.30	0.15

PHENOL-LIKE SUBSTANCES (Usually indicative of industrial wastes; toxic to fish and causes taste and odor problems)

Standards: Annual Average - not more than 0.001 mg/l
Single Value - not more than 0.003 mg/l

Measurable amounts of phenols were not recorded at the water filtration plants in 1971.

SULFATES (Commonly present in water; an indication of industrial wastes)

Standards: Annual Average - not more than 24 mg/l
Single Daily Value or Average - not more than 50 mg/l

The concentrations of sulfates were within the standards in 1971.

Annual average values ranged from 21 to 24 mg/l. The highest single values ranged from 25 to 42 mg/l, well within the standard for single daily values.

TABLE 11. SULFATE CONCENTRATIONS IN LAKE MICHIGAN OPEN WATER, 1971

(Milligrams per liter)

WATER FILTRATION PLANT	MINIMUM	MAXIMUM	ANNUAL AVERAGE
Zion-Benton	18	25	21
Waukegan	17	39	22
North Chicago	16	40	23
Lake Forest	17	42	24
Highland Park	17	42	23
Glencoe	17	40	23
Winnetka	18	40	24
Kenilworth	18	41	23
Wilmette	17	40	23
Evanston	17	38	23
Chicago Central	17	34	22
Chicago South	18	34	23
SWB- Limits:		50	24

PHOSPHATES (A component of sewage, industrial wastes, synthetic detergents and surface run-off; stimulates the growth of algae)

Standard: Not more than 0.02 mg/l (Total PO_4)

In January of 1971, the Pollution Control Board adopted Phosphorus Regulations (PCB R 70-6) which superceded the former SWB-7 standards. The revised standard limits the allowable total phosphate concentration to 0.02 mg/l.

The concentrations of phosphates in filtered samples are listed below.

TABLE 12. PHOSPHATE CONCENTRATIONS IN LAKE MICHIGAN OPEN WATER, 1971

(Milligrams per liter)

WATER FILTRATION PLANT	MINIMUM	MAXIMUM	ANNUAL AVERAGE
Zion-Benton	0.00	0.10	0.02
Waukegan	0.00	0.40	0.04
North Chicago	0.00	0.20	0.04
Lake Forest	0.00	0.50	0.04
Highland Park	0.00	0.80	0.09
Glencoe	0.00	0.20	0.01
Winnetka	0.00	0.60	0.04
Kenilworth	0.00	0.20	0.03
Wilmette	0.00	0.60	0.09
Evanston	0.00	0.70	0.07
Chicago Central	0.00	0.10	0.01
Chicago South	0.00	0.70	0.10
PCB R 70-6 Limit (Total PO_4)		0.02	

FILTRABLE RESIDUE (Total dissolved solids)

Standards: Annual Average - not more than 166 mg/l
Single Daily Value or Average - not more than 200 mg/l

The concentrations of dissolved solids were in general compliance with the standards in 1971.

The highest single daily values at all twelve water filtration plants were within the standard for single daily values. Maximum values ranged from 168 to 191 mg/l. However, the concentrations of dissolved solids were sufficiently high that the annual average standard was exceeded at six of the water plants. In addition, the annual average values at two other plants were at the maximum permissible level.

TABLE 13. FILTRABLE RESIDUE CONCENTRATIONS IN LAKE MICHIGAN OPEN WATER, 1971

(Milligrams per liter)

WATER FILTRATION PLANT	MINIMUM	MAXIMUM	ANNUAL AVERAGE
Zion-Benton	156	168	163
Waukegan	156	184	168
North Chicago	156	181	166
Lake Forest	156	191	167
Highland Park	156	191	168
Glencoe	156	180	166
Winnetka	156	188	168
Kenilworth	156	185	165
Wilmette	156	183	167
Evanston	150	185	167
Chicago Central	156	171	163
Chicago South	150	176	165
SWB-7 Limits: Not more than		200	166

RADIONUCLIDES

(Alpha and beta emissions; any abnormal deviation from background levels may be indicative of pollution from industrial sources, such as nuclear power plants, or from atmospheric fall-out)

Standard: Shall not be present in concentrations that will prevent meeting Public Health Service 1962 Drinking Water Standards after conventional treatment.

The standard is not considered to be in violation as long as the concentration of alpha and beta emitters do not exceed 3 and 1,000 picocuries per liter, respectively.

The emission levels of radionuclides were within the standard in 1971.

The alpha standard was exceeded once at Lake Forest and Kenilworth. These two samples represented 0.8% of the total samples analyzed for alpha emissions in 1971. Maximum alpha values ranged from 1 to 10 pCi/l. The annual average alpha values were less than 1 pCi/l at all of the water plants.

Measurable beta radiation levels ranged from 2 to 19 pCi/l, well within the beta standard. Annual average values ranged from 4 to 6 pCi/l.

TABLE 14. ALPHA AND BETA RADIOACTIVITY LEVELS IN LAKE MICHIGAN OPEN WATER, 1971

(Picocuries per liter)

WATER FILTRATION PLANT	MINIMUM		MAXIMUM		ANNUAL AVERAGE	
	Alpha	Beta	Alpha	Beta	Alpha	Beta
Zion-Benton	0	2	1	6	<1	4
Waukegan	0	3	3	9	<1	5
North Chicago	0	3	2	8	<1	5
Lake Forest	0	3	10	19	<1	6
Highland Park	0	3	2	10	<1	6
Glencoe	0	3	2	8	<1	5
Winnetka	0	2	2	10	<1	6
Kenilworth	0	3	5	16	<1	6
Wilmette	0	2	2	9	<1	5
Evanston	0	3	3	8	<1	5
Chicago Central	0	3	1	6	<1	5
Chicago South	0	3	1	6	<1	4
SWB-7 Limits: Not more than			3	1,000		

FECAL COLIFORM (Bacterial indicators of recent contamination with feces of warm-blooded animals)

Standard:	Based on a minimum of five samples taken over not more than a 30-day period, fecal coliforms shall not exceed a geometric mean of 20 per 100 ml

In March of 1972, the Pollution Control Board adopted a fecal coliform standard for Lake Michigan. Prior to this action, fecal coliform was not part of the water quality regulations for Lake Michigan.

For this report, the 1971 fecal coliform data have been evaluated on the basis of the recently adopted fecal coliform standard. It should be noted that the biweekly sampling schedule of 1971 did not conform to that portion of the standard which calls for evaluation based on a minimum of five samples collected during a 30-day period.

With this in mind fecal coliform counts in the open water were within the standard in 1971.

Geometric mean values ranged from 1 to 3 per 100 ml. The highest single counts ranged from 5/100 ml at the Chicago Central water plant to 400/100 ml at Lake Forest.

TABLE 15. FECAL COLIFORM COUNTS IN LAKE MICHIGAN OPEN WATER, 1971

(Expressed as numbers per 100 milliliters)

WATER FILTRATION PLANT	MINUMUM	MAXIMUM	GEOMETRIC MEAN
Zion-Benton	1	6	1
Waukegan	1	8	2
North Chicago	1	200	1
Lake Forest	1	400	2
Highland Park	1	110	3
Glencoe	1	12	2
Winnetka	1	50	2
Kenilworth	1	44	2
Wilmette	1	8	1
Evanston	1	8	2
Chicago Central	1	5	1
Chicago South	1	10	2
WATER POLLUTION REGULATIONS (206)			20

PLANKTON

(Minute, mostly microscopic plant and animal organisms which drift in the water subject to the action of waves and currents)

Although there are no standards for planktonic organisms, data on their relative abundance are of value in determining eutrophication trends within the lake.

Approximately 96% of the plankton counts in 1971 were composed of phytoplankton organisms (algae). Maximum densities ranged from 3,600 to 8,000/ml. Annual average densities ranged from 2,000 to 4,200/ml. See page 59 for additional data.

TABLE 16. PLANKTON DENSITIES IN LAKE MICHIGAN OPEN WATER, 1971

(Expressed as numbers per milliliter)

WATER FILTRATION PLANT	MINIMUM	MAXIMUM	ANNUAL AVERAGE
Zion-Benton	700	4,100	2,500
Waukegan	800	7,300	3,600
North Chicago	800	6,200	2,600
Lake Forest	1,100	8,000	4,200
Highland Park	900	6,000	3,300
Glencoe	1,800	5,600	3,400
Winnetka	900	6,400	3,500
Kenilworth	1,800	7,300	3,800
Wilmette	1,800	5,700	3,300
Evanston	1,400	7,000	3,400
Chicago Central	900	6,500	2,800
Chicago South	500	3,600	2,000

NITRATE NITROGEN (May contribute to algae blooms and, if present in sufficient concentrations in public water supplies, may cause nitrate poisoning)

Standards have not been established for nitrate nitrogen. For evaluation purposes the 1971 data have been compared to the nitrate nitrogen standard of the U.S. Public Health Service's 1962 Drinking Water Standards. The PHS recommended limit for drinking water is 10 mg/l.

Only two out of 235 samples analyzed for nitrate nitrogen yielded positive results; a value of 0.5 mg/l was recorded once each at the Glencoe and Winnetka water plants. These results were within the PHS limit.

ALKALINITY (The capacity of a solution to neutralize hydrogen ions)

There are no standards for alkalinity.

In the aquatic environment alkalinity in the range of 100 to 120 mg/l serves as a buffer to prevent any abrupt change in the pH of the water from adversely affecting fish and other aquatic organisms.

During the year 256 samples from the water plants were analyzed for alkalinity. Values ranged from 104 to 132 mg/l with an average of 110 mg/l.

HARDNESS (The capacity of water to neutralize soap)

There are no standards for hardness.

Its principal effect is economic; hard water forms scales in boilers, heaters, radiators and pipes, and is responsible for increased consumption of soap and detergents at levels above 100 mg/l. Aside from economic considerations, hard waters have been shown to reduce the detrimental effects of toxic metals on aquatic life.

In 1971, hardness levels in Lake Michigan ranged from 114 to 156 mg/l with an average of 134 mg/l.

OPEN WATER MONITORING - BOAT SAMPLING

RESULTS AND EVALUATION

COLIFORM BACTERIA

Standards:	Annual Average (Arithmetic) - not more than 200 per 100 ml Single Daily Value or Average - not more than 2,500 per 100 ml

Coliform bacteria counts were within the standards in 1971.

The highest single values ranged from 6/100 ml offshore from the Chicago Central water plant to 400/100 ml offshore from the Chicago South plant. The annual average value of 192/100 ml, which was recorded at the 4-mile station offshore from the Chicago South plant, was derived from three samples (refer to Water Plant Section for more statistically valid Chicago South coliform bacteria data).

TABLE 17. COLIFORM BACTERIA COUNTS AT OFFSHORE BOAT STATIONS, 1971

(No./100 ml)

BOAT STATIONS LOCATED 4 MILES OFFSHORE FROM:	MINIMUM	MAXIMUM	ANNUAL AVERAGE
Illinois - Wisconsin State Line	1	10	4
Zion	1	8	4
Waukegan	4	42	19
Highland Park	2	100	36
Winnetka	2	150	43
Evanston	2	70	30
Chicago Central Water Plant	2	6	3
Chicago South Water Plant	36	400	192
SWB-7 Limits: Not more than		2,500	200

FECAL STREPTOCOCCI

Standard: Not more than 25 per 100 ml

Fecal streptococci counts were in general compliance with the standard in 1971.

Although the fecal streptococci levels were in general compliance, 44% of the samples exceeded the standard. The highest single values exceeded the standard at seven of the eight stations.

TABLE 18. FECAL STREPTOCOCCI COUNTS AT OFFSHORE BOAT STATIONS, 1971

(No./100 ml)

BOAT STATIONS LOCATED 4 MILES OFFSHORE FROM:	MINIMUM	MAXIMUM	ANNUAL AVERAGE
Illinois-Wisconsin State Line	1	26	10
Zion	1	14	7
Waukegan	1	58	24
Highland Park	2	180	74
Winnetka	10	150	84
Evanston	1	100	50
Chicago Central Water Plant	1	48	25
Chicago South Water Plant	10	140	75
SWB-7 Limit: Not more than		25	

TURBIDITY

Standard: No turbidity of other than natural origin that will cause substantial visible contrast with the appearance of the water

Turbidity levels were uniformly low at all eight stations in 1971.

The highest single values ranged from 5 to 6 JTU. Annual average values ranged from 4 to 5 JTU.

ODOR

Standard: No obnoxious odor of other than natural origin

Odors of other than natural origin were not noted in the open water in 1971.

OIL

Standard: Substantially free of visible floating oil

Visible floating oil was not observed in the open water in 1971.

FLOATING SOLIDS AND DEBRIS

Standard: Substantially free of floating solids and debris from other than natural sources

Floating solids and debris were not observed in the open water in 1971.

TEMPERATURE

Standard: Please refer to Water Plant Section for temperature standard

Open water temperatures were within the monthly limits in 1971.

The highest monthly temperatures were as follows: 53°F (June), 70°F (August), 70°F (September) and 56°F (October).

pH - HYDROGEN ION CONCENTRATION

Standard: Annual median - within range 8.1 - 8.4
Daily Median - within range 7.7 - 9.0

The annual median standard was exceeded in 1971.

Five of the eight stations exceeded the annual median standard. Annual median values at two other stations were at the maximum permissible level. The single daily pH values ranged from 8.3 to 8.7.

TABLE 19. pH LEVELS AT OFFSHORE BOAT STATIONS, 1971

(pH Units)

BOAT STATIONS LOCATED 4 MILES OFFSHORE FROM:	MINIMUM	MAXIMUM	ANNUAL MEDIAN
Illinois-Wisconsin State Line	8.3	8.5	8.5
Zion	8.3	8.7	8.5
Waukegan	8.3	8.5	8.5
Highland Park	8.3	8.5	8.3
Winnetka	8.3	8.6	8.5
Evanston	8.3	8.6	8.4
Chicago Central Water Plant	8.4	8.6	8.5
Chicago South Water Plant	8.4	8.4	8.4
SWB-7 Limits:	7.7	9.0	within range 8.1 - 8.4

DISSOLVED OXYGEN

Standards:	Annual Average - not less than 90% saturation Single Value - not less than 80% saturation

Dissolved oxygen levels were within the standards in 1971.

The lowest dissolved oxygen levels at the eight stations ranged from 82% saturation offshore from the Chicago Central water plant to 101% saturation off Zion. One of the eight stations, offshore from the Chicago Central plant, did not meet the annual average standard.

TABLE 20. DISSOLVED OXYGEN CONCENTRATIONS AT OFFSHORE BOAT STATIONS, 1971

(Percent saturation)

BOAT STATIONS LOCATED 4 MILES OFFSHORE FROM:	MINIMUM	MAXIMUM	ANNUAL AVERAGE
Illinois-Wisconsin State Line	99	104	102
Zion	101	110	106
Waukegan	98	98	98
Highland Park	98	102	100
Winnetka	88	103	96
Evanston	89	100	95
Chicago Central Water Plant	82	93	88
Chicago South Water Plant	92	95	94
SWB-7 Limits: Not less than	80		90

AMMONIA

Standards: Annual Average - 0.02 mg/l
Single Daily Value or Average - 0.06 mg/l

Ammonia (NH_3) concentrations exceeded the annual average standard in 1971.

The annual average standard was exceeded at all eight station; annual averages ranged from 0.03 mg/l offshore from the Illinois-Wisconsin State Line to 0.12 mg/l off Waukegan. The highest single values exceeded the single daily value standard at seven stations. In all, 44% of the samples analyzed for ammonia exceeded the standard for single values.

TABLE 21. AMMONIA (NH_3) CONCENTRATIONS AT OFFSHORE BOAT STATIONS, 1971

(Milligrams per liter)

BOAT STATIONS LOCATED 4 MILES OFFSHORE FROM:	MINIMUM	MAXIMUM	ANNUAL AVERAGE
Illinois-Wisconsin State Line	0.00	0.05	0.03
Zion	0.00	0.10	0.03
Waukegan	0.10	0.15	0.12
Highland Park	0.00	0.20	0.08
Winnetka	0.00	0.10	0.05
Evanston	0.00	0.10	0.05
Chicago Central Water Plant	0.10	0.10	0.10
Chicago South Water Plant	0.00	0.10	0.05
SWB-7 Limits: Not more than		0.06	0.02

METHYLENE BLUE ACTIVE SUBSTANCE

Standards:	Annual Average - not more than 0.05 mg/l Single Daily Value or Average - not more than 0.20 mg/l

MBAS concentrations exceeded the annual average standard in 1971.

The annual average values at all eight stations exceeded the standard; values ranged from 0.11 to 0.15 mg/l. None of the single values exceeded the standard for single daily values although the MBAS concentrations were at sufficiently high levels to affect the annual averages.

TABLE 22. MBAS CONCENTRATIONS AT OFFSHORE BOAT STATIONS, 1971

(Milligrams per liter)

BOAT STATIONS LOCATED 4 MILES OFFSHORE FROM:	MINIMUM	MAXIMUM	ANNUAL AVERAGE
Illinois-Wisconsin State Line	0.10	0.20	0.13
Zion	0.10	0.15	0.11
Waukegan	0.10	0.20	0.13
Highland Park	0.10	0.20	0.15
Winnetka	0.10	0.20	0.14
Evanston	0.10	0.20	0.14
Chicago Central Water Plant	0.10	0.20	0.15
Chciago South Water Plant	0.10	0.20	0.15
SWB-7 Limits: Not more than		0.20	0.05

CHLORIDES

Standards:	Annual Average - not more than 9 mg/l Single Daily Value or Average - not more than 15 mg/l

Chloride concentrations were within the standards in 1971.

The annual average at all eight stations was 9 mg/l, the maximum permissible value. The highest single values ranged from 9 to 10 mg/l.

TABLE 23. CHLORIDE CONCENTRATIONS AT OFFSHORE BOAT STATIONS, 1971

(Milligrams per liter)

BOAT STATIONS LOCATED 4 MILES OFFSHORE FROM:	MINIMUM	MAXIMUM	ANNUAL AVERAGE
Illinois-Wisconsin State Line	9	10	9
Zion	8	10	9
Waukegan	9	9	9
Highland Park	8	10	9
Winnetka	9	10	9
Evanston	9	9	9
Chicago Central Water Plant	9	9	9
Chicago South Water Plant	9	9	9
SWB-7 Limits: Not more than		15	9

CYANIDES

Standard: Single Value - not more than 0.025 mg/l

Measurable amounts of cyanides were not recorded in the open water in 1971.

FLUORIDES

Standard: Annual Average - not more than 1.0 mg/l
Single Daily Value or Average - not more than 1.3 mg/l

Fluoride concentrations were within the standards in 1971.

The highest annual average value, 0.2 mg/l, was recorded offshore from the Chicago Central water plant. The annual average at the seven other stations was 0.1 mg/l. The highest single values ranged from 0.2 to 0.3 mg/l.

DISSOLVED IRON

Standards:	Annual Average - not more than 0.15 mg/l Single Daily Value or Average - not more than 0.30 mg/l

Dissolved iron concentrations were within the standards in 1971.

Annual averages ranged from less than 0.01 to 0.02 mg/l. The highest single values ranged from 0.01 to 0.04 mg/l.

PHENOL-LIKE SUBSTANCES

Standards:	Annual Average - not more than 0.001 mg/l Single Daily Value or Average - not more than 0.003 mg/l

Measurable amounts of phenols were not recorded in the open water in 1971.

SULFATES

Standards:	Annual Average - not more than 24 mg/l Single Daily Value or Average - not more than 50 mg/l

Sulfate concentrations were within the standards in 1971.

Annual averages ranged from 18 to 21 mg/l. The highest single values ranged from 19 to 24 mg/l.

TABLE 24. SULFATE CONCENTRATIONS AT OFFSHORE BOAT STATIONS, 1971

(Milligrams per liter)

BOAT STATIONS LOCATED 4 MILES OFFSHORE FROM:	MINIMUM	MAXIMUM	ANNUAL AVERAGE
Illinois-Wisconsin State Line	19	24	21
Zion	20	21	20
Waukegan	19	22	21
Highland Park	20	21	21
Winnetka	16	22	19
Evanston	16	23	19
Chicago Central Water Plant	16	19	18
Chicago South Water Plant	18	19	19
SWB-7 Limits: Not more than		50	24

PHOSPHATES

Standard: Not more than 0.02 mg/l (Total PO_4)

The concentrations of phosphates in filtered samples are listed below.

TABLE 25. PHOSPHATE CONCENTRATIONS AT OFFSHORE BOAT STATIONS, 1971

(Milligrams per liter)

BOAT STATIONS LOCATED 4 MILES OFFSHORE FROM:	MINIMUM	MAXIMUM	ANNUAL AVERAGE
Illinois-Wisconsin State Line	0.00	0.00	0.00
Zion	0.00	0.00	0.00
Waukegan	0.00	0.00	0.00
Highland Park	0.00	0.00	0.00
Winnetka	0.00	0.10	0.03
Evanston	0.00	0.00	0.00
Chicago Central Water Plant	0.00	0.10	0.05
Chicago South Water Plant	0.00	0.00	0.00
PCB R70-6 Limit(Total PO_4)		0.02	

FILTRABLE RESIDUE (Total Dissolved Solids)

Standards: Annual average - not more than 166 mg/l
Single Daily Value or Average - not more than 200 mg/l

The concentrations of dissolved solids (filtrable residue) were within the standards in 1971.

Annual averages ranged from 160 to 166 mg/l. The highest single values ranged from 162 to 169 mg/l.

TABLE 26. FILTRABLE RESIDUE CONCENTRATIONS AT OFFSHORE BOAT STATIONS, 1971

(Milligrams per liter)

BOAT STATIONS LOCATED 4 MILES OFFSHORE FROM:	MINIMUM	MAXIMUM	ANNUAL AVERAGE
Illinois-Wisconsin State Line	162	169	164
Zion	156	162	161
Waukegan	156	162	160
Highland Park	156	168	162
Winnetka	156	168	162
Evanston	156	168	161
Chicago Central Water Plant	162	162	162
Chicago South Water Plant	162	168	166
SWB-7 Limits: Not more than		200	166

RADIONUCLIDES

Standard: Shall not be present in concentrations that will prevent meeting PHS 1962 Drinking Water Standards after conventional treatment

Alpha and beta radioactivity levels were within the standard.

Measurable alpha values were recorded only at the stations offshore from the Illinois-Wisconsin State Line and Highland Park. At both locations an alpha reading of 1 pCi/l was recorded once.

Beta emission levels were uniformly low with a range of 0 to 6 pCi/l.

FECAL COLIFORM

Standard: Based on a minimum of five samples taken over not more than a 30-day period, fecal coliforms shall not exceed a geometric mean of 20 per 100 ml.

Fecal coliform bacteria counts were within the standard in 1971.

The highest geometric mean value was 2/100 ml, which was recorded offshore from Evanston. The geometric mean value at the other seven stations was 1/100 ml.

TABLE 27. FECAL COLIFORM COUNTS AT OFFSHORE BOAT STATIONS, 1971

(No./100 ml)

BOAT STATIONS LOCATED 4 MILES OFFSHORE FROM:	MINIMUM	MAXIMUM	GEOMETRIC MEAN
Illinois-Wisconsin State Line	1	2	1
Zion	1	1	1
Waukegan	1	1	1
Highland Park	1	1	1
Winnetka	1	1	1
Evanston	1	22	2
Chicago Central Water Plant	1	1	1
Chicago South Water Plant	1	1	1
Water Pollution Regulations (206)			20

PLANKTON

The highest plankton densities ranged from 2,100/ml offshore from Waukegan to 5,500/ml offshore from Zion. Annual average densities ranged from 2,100 to 3,400/ml.

TABLE 28. PLANKTON DENSITIES AT OFFSHORE BOAT STATIONS, 1971

BOAT STATIONS LOCATED 4 MILES OFFSHORE FROM:	MINIMUM	MAXIMUM	ANNUAL AVERAGE
Illinois-Wisconsin State Line	2,700	3,400	2,900
Zion	1,500	5,500	3,000
Waukegan	2,000	2,100	2,100
Highland Park	2,400	2,600	2,500
Winnetka	2,400	3,400	2,800
Evanston	2,700	4,000	3,400
Chicago Central Water Plant	2,200	3,700	3,000
Chicago South Water Plant	2,900	3,100	3,000

SECCHI DISC MEASUREMENTS (A measure of light penetration in water)

There is no Secchi disc standard. Secchi disc measurements are used to determine the clarity or transparency of a body of water which, in turn, is affected by the presence or absence of suspended and colloidal matter.

In 1971, the areas of greatest light penetration were recorded at the offshore stations north of Chicago, where the maximum Secchi disc readings ranged from 13 to 15 feet.

TABLE 29. SECCHI DISC MEASUREMENTS AT OFFSHORE BOAT STATIONS, 1971

(Expressed in feet)

BOAT STATIONS LOCATED 4 MILES OFFSHORE FROM:	MINIMUM	MAXIMUM	ANNUAL AVERAGE
Illinois-Wisconsin State Line	10	15	13
Zion	9	14	11
Waukegan	15	15	15
Highland Park	10	13	12
Winnetka	12	14	13
Evanston	11	15	13
Chicago Central Water Plant	10	10	10
Chicago South Water Plant	10	10	10

NITRATE NITROGEN

Twenty-seven samples were analyzed for nitrate nitrogen; all values were zero.

ALKALINITY

Twenty-six samples were analyzed for alkalinity at the 4-mile stations. All values were 108 mg/l except for one value of 104 mg/l

HARDNESS

Twenty-seven samples were analyzed for hardness. Values ranged from 120 to 160 mg/l with an average of 132 mg/l.

WATER QUALITY MONITORING AT U.S. ESTABLISHED DUMP AREA, 1971

RESULTS AND EVALUATION

The following results and evaluations are based on water samples collected at the Dump Area during a boat cruise conducted in October 1971. Water quality standards included in the section on Open Water Monitoring are applicable to the Dump Area.

COLIFORM BACTERIA

Coliform bacteria counts were within the standards. The annual average count was 50/100 ml.

FECAL STREPTOCOCCI

Fecal streptococci counts were within the standard. Two samples, with values 30 and 160/100 ml, exceeded the standard.

TURBIDITY

Turbidity levels were within the standard. Single values ranged from 3 to 5 JTU.

ODOR

No obnoxious odors were detected at the dump area.

OIL

There were no sightings of floating oil in 1971.

FLOATING SOLIDS AND DEBRIS

Floating solids and debris were not observed at the dump area in 1971.

TEMPERATURE

Temperature levels were within the standards. Temperature measurements made in October of 1971 were just within the October standard of 65°F.

pH - HYDROGEN ION CONCENTRATION

The annual median standard was exceeded at the dump area in 1971. Single values ranged from 8.4 to 8.6.

DISSOLVED OXYGEN

Dissolved oxygen levels were within the standards in 1971. The annual average was 106% saturation with a range from 95 to 112% saturation.

AMMONIA

Measurable amounts of ammonia (NH_3) were not recorded in 1971.

METHYLENE BLUE ACTIVE SUBSTANCE

The MBAS annual average value exceeded the annual average standard. The single values did not exceed the standard for single daily values.

CHLORIDES

Chloride concentrations were within the standards. The annual average was 8 mg/l; single values ranged from 8 to 9 mg/l.

CYANIDES

Measurable amounts of cyanides were not recorded in 1971.

FLUORIDES

Fluoride concentrations were within the standards. A uniform value of 0.1 mg/l was recorded for all of the samples.

DISSOLVED IRON

Dissolved iron concentrations were within the standards. The range of single values was from 0.00 to 0.01 mg/l. The annual average was less than 0.01 mg/l.

PHENOL - LIKE SUBSTANCES

Measurable amounts of phenols were not recorded in 1971.

SULFATES

Sulfate concentrations were within the standards. The annual average was 20 mg/l; the highest single value was 21 mg/l.

PHOSPHATES

Measurable amounts of phosphates (PO_4) were not recorded in 1971.

FILTRABLE RESIDUE (Total Dissolved Solids)

The levels of dissolved solids were within the standards. The highest single value was 162 mg/l; the 1971 annual average was 161 mg/l.

RADIONUCLIDES

Measurable levels of alpha emissions were not recorded in 1971. Beta radioactivity levels ranged from 3 to 4 pCi/l.

FECAL COLIFORM

Fecal coliform bacteria counts were within the standard. The geometric mean value was 6/100 ml.

PLANKTON

Plankton densities ranged from 2,300 to 3,300/ml with an annual average of 2,900/ml.

NITRATE NITROGEN

Measurable amounts of nitrate nitrogen were not recorded in 1971.

ALKALINITY

All alkalinity values were 108 mg/l.

HARDNESS

All hardness values were 130 mg/l.

TABLE 30. WATER QUALITY AT THE U.S. ESTABLISHED DUMP AREA, 1971

PARAMETER	MINIMUM	MAXIMUM	ANNUAL AVERAGE	SWB-7 ANNUAL AVERAGE STANDARD
Coliform Bacteria	50	50	50	Not more than 200/100 ml
Fecal Streptococci	5	160	43	All samples 25/100 ml
Turbidity (JTU)	3	5	4	No Standard
Temperature	64	64	64	65°F for October *
pH	8.4	8.6	8.5**	Within range 8.1 - 8.4
Dissolved Oxygen	95	112	106	Not less than 90% saturation
MBAS	0.10	0.10	0.10	Not more than 0.05 mg/l
Chlorides	8	9	8	Not more than 9 mg/l
Dissolved Iron	0.00	0.01	<0.01	Not more than 0.15 mg/l
Sulfates	20	21	20	Not more than 24 mg/l
Filtrable Residue	156	162	161	Not more than 166 mg/l
Radionuclides				
alpha	0	0	0	All samples 3 pCi/l
beta	3	4	4	All samples 1,000 pCi/l
Fecal Coliform	5	10	6***	Not more than 20/100 ml
Plankton/ml.	2,300	3,300	2,900	No Standard

* PCB R 70-2
** Annual Median
*** Water Pollution Regulations (section 206d) Geometric Mean

WATER QUALITY MONITORING AT CALUMET HARBOR, 1971

RESULTS AND EVALUATION

The following results and evaluations are based on water samples collected at Calumet Harbor during three boat sampling cruises. Water quality standards in SWB-15, are applicable to Calumet Harbor.

COLIFORM BACTERIA

Standards: Annual Average (Arithmetic) - not more than 2,000 per 100 ml
Single Daily Value or Average - not more than 5,000 per 100 ml

Coliform bacteria counts were within the standards.

Annual average counts were 75 and 400/100 ml at the State Line and Calumet River Mouth stations, respectively. The highest single count recorded in 1971 was 400/100 ml, which was recorded at the Calumet River Mouth station.

FECAL STREPTOCOCCI

Standard: Not more than 100 per 100 ml

Fecal streptococci counts were within the standard.

The highest count recorded in 1971, 30/100 ml, was from a sample collected at the Calumet River Mouth station. The maximum count recorded at the State Line station was 5/100 ml.

TURBIDITY

Standard: No turbidity of other than natural origin that will cause substantial visible contrast with the natural appearance of water

Turbidity levels within Calumet Harbor were considered to be low in 1971.

The highest value recorded at both sampling stations was 6 JTU.

ODOR

Standard: No obnoxious odor of other than natural origin.

Obnoxious odors were not detected in water samples collected within the Calumet Harbor Basin.

TEMPERATURE

Standard:	August	September	October
	80°F	80°F	65°F

Thermal standards adopted by the Pollution Control Board in June of 1971 limit the monthly temperatures for August, September and October (the months involved in the sampling) as outlined above.

Temperature levels were within the standard.

At the State Line station, the monthly temperatures for August, September and October were 69, 64 and 63°F, respectively. The corresponding monthly tempertures at the Calumet River Mouth station were 68, 67 and 56°F.

OIL

Standard: Substantially free of visible floating oil

This standard was exceeded in 1971.

Visible floating oil was observed on two of the three sampling trips at both stations.

FLOATING SOLIDS AND DEBRIS

Standard: Substantially free of floating solids and debris from other than natural sources

Significant amounts of floating solids and debris were not observed within the Calumet Harbor Basin.

pH - HYDROGEN ION CONCENTRATION

Standards: Annual Median - within range 8.0 - 8.5
Daily Median - within range 7.5 - 9.0

The pH levels were within the standards.

The annual median value at both stations was 8.3. The pH range was from 8.2 to 8.3.

DISSOLVED OXYGEN

Standards: Annual Average - not less than 80% saturation
Single Daily Value or Average - not less than 65% saturation

Dissolved oxygen levels were within the standards.

Minimum dissolved oxygen values at the State Line and Calumet Harbor Mouth stations were 78 and 68% saturation, respectively. The lowest annual average, 83% saturation, was recorded at the Calumet River Mouth station.

AMMONIA

Standards: Annual Average - 0.06 mg/l
Single Daily Value or Average - 0.15 mg/l

Ammonia (NH_3) concentrations exceeded the annual average standard at both stations, and the single daily value standard was exceeded at the Calumet River Mouth station.

Annual averages ranged from 0.07 mg/l at the State Line station to 0.23 mg/l at the Calumet River Mouth station. Two-thirds of the samples analyzed for ammonia at the Calumet River Mouth station exceeded the standard for single daily values.

METHYLENE BLUE ACTIVE SUBSTANCE

Standards: Annual Average - not more than 0.10 mg/l
Single Daily Value or Average - not more than 0.30 mg/l

MBAS values exceeded the annual average standard in 1971.

The annual averages at the State Line and Calumet River Mouth stations were 0.12 and 0.15 mg/l, respectively. The highest single value recorded in 1971 was 0.20 mg/l from the Calumet River Mouth station.

CHLORIDES

Standards: Annual Average - not more than 18 mg/l
Single Daily Value or Average - not more than 30 mg/l

Chloride concentrations were within the standards.

Annual average values at the State Line and Calumet River Mouth stations were 9 and 12 mg/l, respectively. Single values ranged from 8 to 10 mg/l at the State Line station and from 10 to 12 mg/l at the Calumet River Mouth station.

CYANIDES

Standard: Single Value - less than 0.1 mg/l

Cyanide concentrations were within the standard.

Only one sample yielded a positive reading in 1971. This was 0.08 mg/l, which was recorded at the Calumet River Mouth station.

FLUORIDES

Standards: Annual Average - not more than 1.0 mg/l
Single Daily Value or Average - not more than 1.3 mg/l

Fluoride concentrations were within the standards.

Annual averages at the State Line and Calumet River Mouth stations were 0.1 and 0.8 mg/l, respectively. The single daily value standard was exceeded once at the Calumet River Mouth station (2.0 mg/l).

DISSOLVED IRON

Standards: Annual Average - not more than 0.15 mg/l
Single Daily Value or Average - not more than 0.30 mg/l

Dissolved iron concentrations were within the standards.

The annual average values at the State Line and Calumet River Mouth stations were 0.04 and 0.03 mg/l, respectively. The highest single value recorded in 1971 was 0.06 mg/l, which was recorded at the State Line station.

PHENOL - LIKE SUBSTANCES

Standards: Annual Average - not more than 0.002 mg/l
Single Daily Value or Average - not more than 0.005 mg/l

Measurable amounts of phenols were not recorded within the Calumet Harbor Basin.

SULFATES

Standards: Annual Average - not more than 36 mg/l
Single Daily Value or Average - not more than 75 mg/l

The concentrations of sulfates were within the standards.

Annual averages ranged from 19 mg/l at the State Line station to 21 mg/l at the Calumet River Mouth station. The highest single value was recorded at the Calumet River Mouth station (22 mg/l).

PHOSPHATES

Standard:	Single Value - not more than 0.02 mg/l (Total PO_4)

The only positive value was recorded at the State Line station (0.20 mg/l).

FILTRABLE RESIDUE (Total dissolved solids)

Standards:	Annual Average - not more than 191 mg/l Single Daily Value or Average - not more than 230 mg/l

The concentrations of dissolved solids were within the standards.

The annual averages at the State Line and Calumet River Mouth stations were 166 and 168 mg/l, respectively. The highest single value, 180 mg/l, was recorded at the Calumet River Mouth station.

RADIONUCLIDES

Standard:	Shall not be present in concentrations that will prevent meeting PHS 1962 Drinking Water Standards after conventional treatment

Alpha and beta emission levels were within the standard.

Measurable amounts of alpha radiation were recorded once within the Calumet Harbor Basin (1 pCi/l at the State Line station).

The highest beta value, 6 pCi/l, was recorded at the Calumet River Mouth station.

FECAL COLIFORM

Standard:	Based on a minimum of five samples taken over not more than a 30-day period, fecal coliforms shall not exceed a geometric mean of 20 per 100 ml

While the Calumet River Mouth station, as part of the Calumet River, is governed by a less restrictive fecal coliform standard than for Lake Michigan stations, this station has been evaluated on the basis of the Lake Michigan standard for this report.

Fecal coliform bacteria counts were within the standard.

The geometric mean values for the State Line and Calumet River Mouth stations were 16 and 10/100 ml, respectively.

SECCHI DISC MEASUREMENTS

Secchi disc readings were considerably lower within the Calumet Harbor Basin as compared to the open water of Lake Michigan. Readings within the harbor ranged from 6 to 8 feet, with average readings of 7 and 6 feet at the State Line and Calumet River Mouth stations, respectively. The average readings for the open water stations ranged from 10 to 15 feet (Table 29).

NITRATE NITROGEN

Measurable amounts of nitrate nitrogen were not recorded within Calumet Harbor.

ALKALINITY

Alkalinity values at both stations were 108 mg/l.

HARDNESS

All hardness values recorded in 1971 were 130 mg/l.

LAKE BED SURVEY

GENERAL INFORMATION

Senate Bill 1794, passed by the 75th General Assembly, authorized the State to conduct lake bed surveys in order to evaluate the ecology of Lake Michigan waters. Regulations incorporated in SWB-7 required that bottom deposits in Lake Michigan be "Substantially free of contaminants that will: (1) adversely affect the composition of the bottom fauna; (2) interfere with the spawning of fish or their eggs; (3) adversely alter the physical or chemical nature of the bottom."

During 1971, bottom samples from 132 stations were collected during the lake bed survey. These samples, collected with Ponar and Petersen dredges, were washed through a U.S. Standard No. 30 mesh screen. Bottom organisms collected in this manner were preserved for identification in the laboratory.

Based upon the numbers and kinds of organisms found at each station, a determination was made as to whether each station represented a balanced, unbalanced or polluted environment. A balanced bottom population includes a variety of species which are predominantly intolerant to polluted conditions. A degraded environment includes fewer species which are predominantly tolerant to polluted conditions.

RESULTS AND EVALUATION OF MONITORING

ESTABLISHED STATIONS

Bottom samples were collected at sixty-three established lake stations from Zion to Calumet Harbor in 1971 (Figs. 1 and 2). These stations were located at distances ranging from less than 1 mile to 9 miles offshore and were in depths from 15 to 84 feet.

Conditions at 33 stations (52%) were indicative of a biologically degraded environment. Nineteen stations (Stations 3, 5, 6, 13, 19, 20, 23, 30, 31, 32, 34, 35, 36, 37, 40, 50, 55, 56, and 62) were found to be seriously polluted. Continuous enrichment of the environment provides conditions which are conducive to the development of a large number of aquatic worms. Aquatic worms were present in numbers ranging from 102 to 5,100 individuals per square foot at these nineteen stations (See Tables 31 and 32).

SPECIAL STATIONS

In addition to the bottom samples collected at the established stations, 69 special samples were collected at the following locations: Commonwealth Edison plant in Zion, Great Lakes Naval Training Center, United States Steel in Waukegan, Lincoln Park Gun Club, Burnham Park Harbor, Jackson Park Outer Harbor, Calumet Harbor and at the U.S. Established Dump Area.

Of the 69 special samples 54 or 78% were biologically degraded. It should be cautioned that these samples are not directly comparable with the samples from the established stations since the majority of these represent special situations such as harbors and inshore areas subjected to the influence of waste discharges.

The findings related to the U.S. Established Dump Area will be discussed here. The other special stations are discussed separately (Tables 33-39).

TABLE 31. Bottom organisms collected during benthic surveys from Zion to Evanston. Data are expressed as numbers of organisms per square foot.

STATION	CADDISFLY LARVAE	SCUDS	AQUATIC SOW BUGS	FINGERNAIL CLAMS	GILLED SNAILS	MIDGE LARVAE	FLATWORMS	PULMONATE SNAILS	LEECHES	AQUATIC WORMS	POLLUTION CLASSIFICATION
1	-	-	-	-	NO SAMPLE		-	-	-	-	-
2	-	391	-	7	-	2	-	2	-	40	Bal.
3	-	116	-	1500	11	43	-	5	-	5100	Pol.
4	-	1700	-	952	2	5	-	-	2	586	Unbal.
5	-	716	2	591	46	64	-	14	9	1500	Pol.
6	-	116	-	372	11	221	-	5	4	1200	Pol.
7	-	310	-	47	1	7	-	-	-	117	Bal.
8	-	842	-	829	126	45	-	1	1	408	Unbal.
9	-	119	-	12	2	20	-	4	2	107	Bal.
10	-	3	-	19	2	3	-	1	-	17	Bal.
11	-	34	-	39	2	5	-	7	-	57	Bal.
12	-	4000	-	1000	214	25	-	4	5	497	Bal.
13	-	91	-	4	-	12	-	-	3	206	Pol.
14	-	18	-	12	2	9	-	-	-	85	Bal.
15	2	56	41	75	7	2	1	-	1	22	Bal.
16	-	-	-	-	NO SAMPLE		-	-	-	-	-
17	-	21	5	5	-	9	-	44	2	30	Bal.
18	-	-	-	ROCK INSUFFICIENT SAMPLE				-	-	-	-
19	-	61	-	5	-	168	-	43	11	236	Pol.
20	-	2	-	-	-	57	-	2	4	299	Pol.
21	-	8	-	1	-	3	4	16	2	9	Bal.
22	-	7	-	2	-	12	-	14	7	69	Unbal.
23	-	11	4	14	-	14	-	2	-	203	Pol.
24	1	186	-	2	2	7	-	3	-	7	Bal.
25	1	67	-	3	25	6	-	-	-	1	Bal.
26	-	-	-	1	-	27	-	-	-	9	Unbal.
27	-	-	-	-	-	4	-	5	-	11	Unbal.
28	4	772	-	23	14	15	-	4	-	146	Bal.
29	-	425	-	2	-	10	-	-	-	5	Bal.
30	-	4	-	2	-	9	-	11	7	358	Pol.
31	2	53	5	7	-	322	-	12	2	671	Pol.
32	-	73	-	1100	-	64	4	9	7	3500	Pol.
33	-	2	-	4	-	-	-	4	-	18	Unbal.
34	1	17	-	36	5	21	7	1	-	141	Pol.
35	-	13	-	485	-	39	-	10	4	4900	Pol.
36	2	4	-	11	-	-	2	5	2	137	Pol.

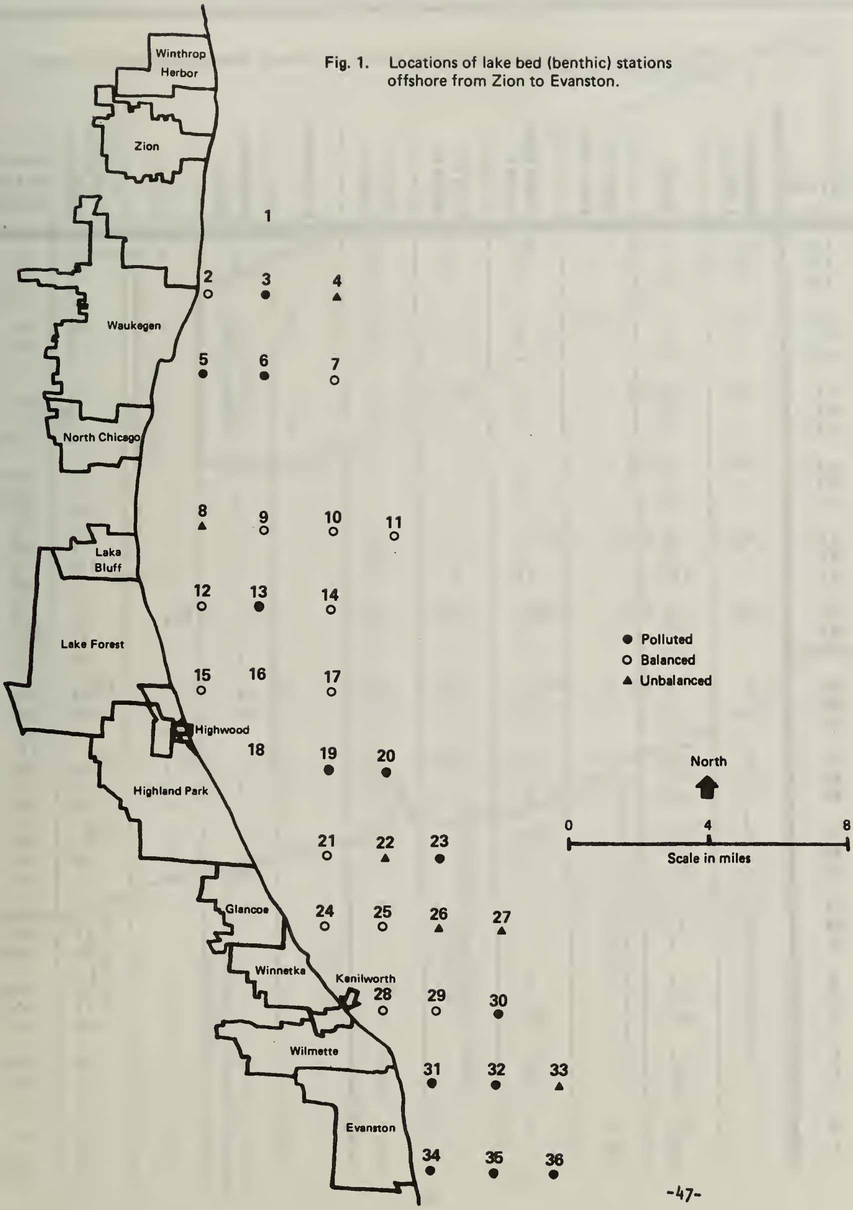
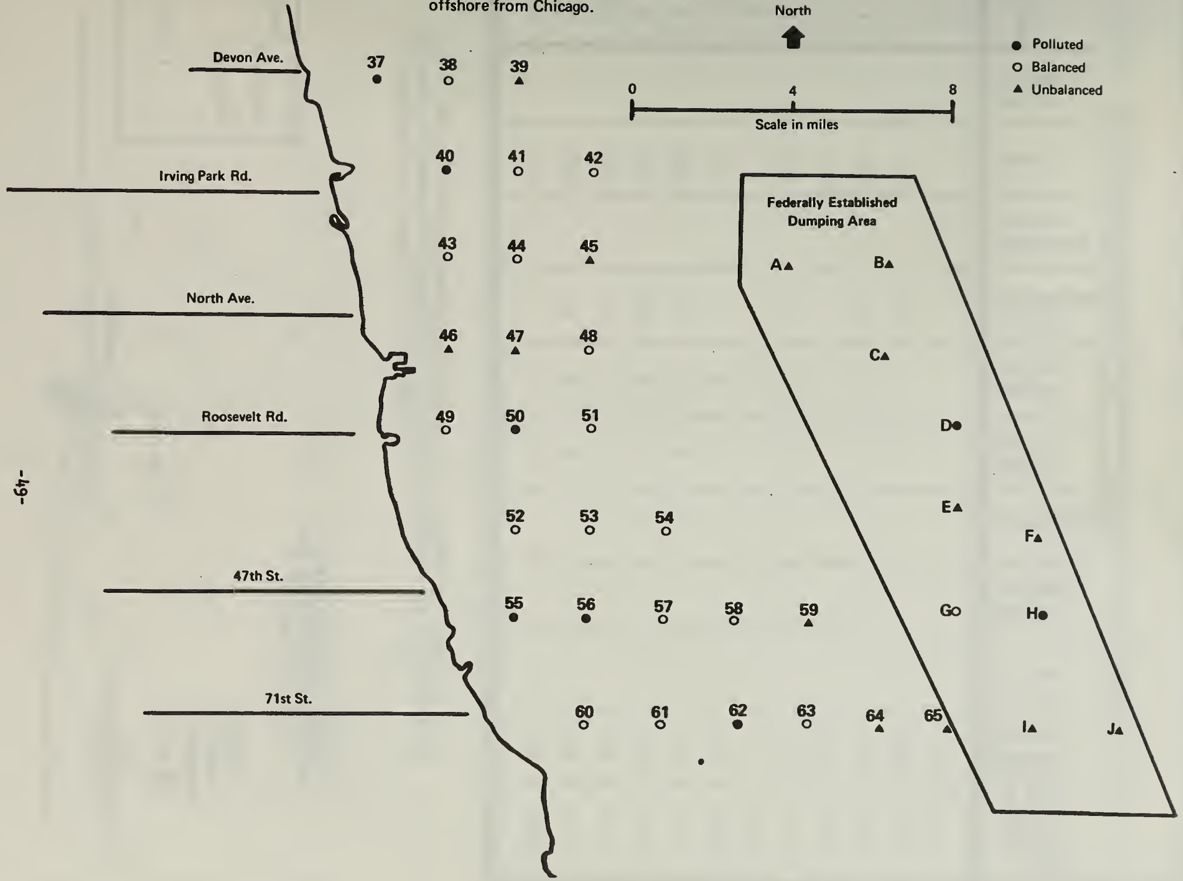


Fig. 1. Locations of lake bed (benthic) stations offshore from Zion to Evanston.

TABLE 32. Bottom organisms collected during benthic surveys off Chicago. Data are expressed as numbers of organisms per square foot.

STATION	CADDISFLY LARVAE	SCUDS	AQUATIC SOW BUGS	FINGERNAIL CLAMS	GILLED SNAILS	MIDGE LARVAE	FLATWORMS	PULMONATE SNAILS	LEECHES	AQUATIC WORMS	POLLUTION CLASSIFICATION
37	1	11	1	53	-	13	2	3	4	2091	Pol.
38	1	8	-	4	3	9	-	12	-	25	Bal.
39	-	-	-	-	-	12	-	2	-	5	Unbal.
40	-	2	-	6	2	3	-	5	1	1129	Pol.
41	-	5	-	4	1	-	-	8	-	10	Bal.
42	-	134	-	-	-	1	-	-	-	4	Bal.
43	-	308	-	114	11	5	-	-	-	9	Bal.
44	-	89	-	7	-	2	-	2	-	4	Bal.
45	-	5	-	-	-	-	-	-	2	28	Unbal.
46	-	21	-	-	-	-	-	-	-	-	Unbal.
47	-	4	-	4	-	-	-	4	-	-	Unbal.
48	1	16	-	5	-	1	-	4	-	30	Bal.
49	-	28	-	17	7	32	-	-	-	8	Bal.
50	-	10	-	7	-	16	-	2	11	113	Pol.
51	-	633	-	47	4	1	-	-	-	2	Bal.
52	-	198	-	126	36	12	-	3	6	23	Bal.
53	-	196	-	2	-	3	-	4	-	-	Bal.
54	-	712	-	112	10	2	-	2	1	26	Bal.
55	2	4	-	12	-	48	-	16	2	224	Pol.
56	-	5	-	2	-	77	-	12	-	265	Pol.
57	-	316	-	13	4	2	-	-	-	4	Bal.
58	2	287	-	45	3	6	-	-	3	45	Bal.
59	-	71	-	-	-	28	-	5	-	71	Unbal.
60	-	259	-	88	2	14	-	-	3	18	Bal.
61	-	273	-	198	27	21	-	-	3	71	Bal.
62	-	27	-	4	-	3	-	-	2	102	Pol.
63	-	101	-	4	-	3	-	4	-	4	Bal.
64	-	42	-	-	-	1	-	-	-	-	Unbal.
65	-	47	-	-	-	1	-	-	-	17	Unbal.
A	-	8	-	-	2	4	-	-	-	24	Unbal.
B	-	3	-	6	1	2	-	-	-	25	Unbal.
C	-	69	-	4	-	-	-	-	-	18	Unbal.
D	-	284	1	155	-	3	-	-	1	2844	Pol.
E	1	2	-	12	-	5	-	-	-	58	Unbal.
F	-	34	-	6	-	2	-	-	-	69	Unbal.
G	-	82	-	21	-	2	-	-	-	3	Bal.
H	-	55	-	6	-	2	-	-	1	123	Pol.
I	-	5	39	-	-	9	-	2	1	52	Unbal.
J	-	36	1	-	-	2	-	-	-	56	Unbal.

Fig. 2. Locations of lake bed (benthic) stations offshore from Chicago.



Nine of the 10 stations at the U.S. Established Dump Area (Table 32 and Fig. 2) were indicative of a biologically degraded environment. The most seriously polluted areas were found at Stations D and H, where aquatic worm populations were present in concentrations of 2,844 and 123 individuals per square foot, respectively. The lake bottom at the Dump Area consists primarily of clay, sand, pebbles, rocks and some unnatural debris.

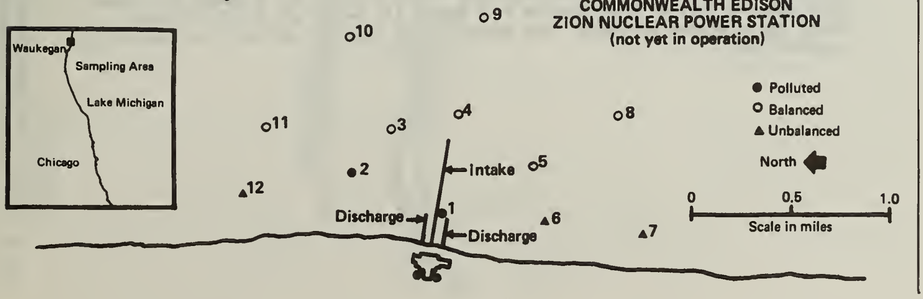
COMMONWEALTH EDISON NUCLEAR PLANT, ZION

TABLE 33. Bottom organisms collected during benthic sampling off the Commonwealth Edison plant at Zion. Data are expressed as numbers of organisms per square foot.

STATION	CADDISFLY LARVAE	SCUDS	AQUATIC SOW BUGS	FINGERNAIL CLAMS	GILLED SNAILS	MIDGE LARVAE	FLATWORMS	PULMONATE SNAILS	LEECHES	AQUATIC WORMS	POLLUTION CLASSIFICATION
1		-		-	-	9		-	-	917	Pol.
2		138		20	2	8		-	-	428	Pol.
3		441		77	6	4		4	-	43	Bal.
4		173		1	-	-		-	1	21	Bal.
5		315		20	2	4		1	-	83	Bal.
6		1		1	1	1		-	-	11	Unbal.
7		20		4	2	2		2	1	69	Unbal.
8		568		37	1	5		-	-	30	Bal.
9		1100		233	9	4		1	-	90	Bal.
10		522		52	2	1		2	-	29	Bal.
11		843		92	4	3		2	-	129	Bal
12		21		-	-	2		-	-	38	Unbal.

Five of the twelve bottom samples collected off the Commonwealth Edison plant in Zion were indicative of a biologically degraded environment. The lake bottom in this area consisted primarily of fine sand.

Fig. 3



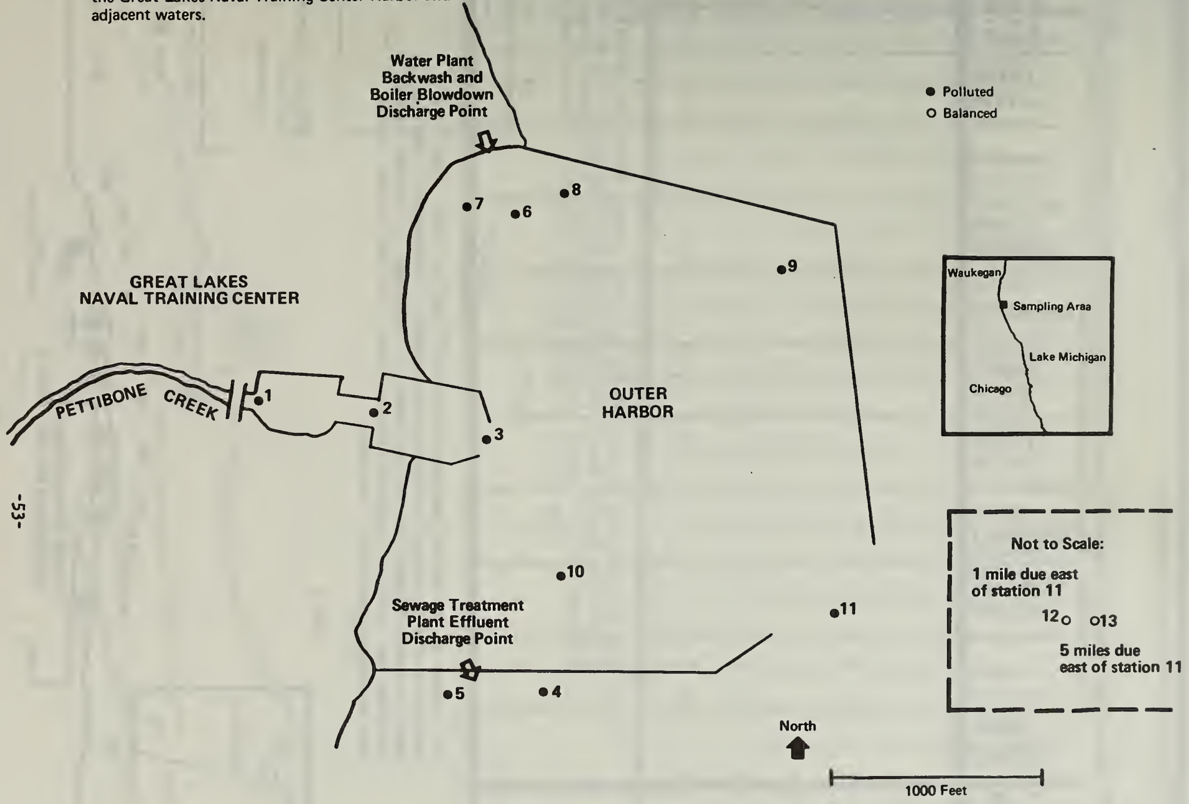
GREAT LAKES NAVAL TRAINING CENTER, NORTH CHICAGO

TABLE 34. Bottom organisms collected during benthic sampling in the Great Lakes Naval Training Center Harbor and adjacent waters. Data are expressed as numbers of organisms per square foot.

STATION	CADDISFLY LARVAE	SCUDS	AQUATIC SOW BUGS	FINGERNAIL CLAMS	GILLED SNAILS	MIDGE LARVAE	FLATWORMS	PULMONATE SNAILS	LEECHES	AQUATIC WORMS	POLLUTION CLASSIFI-CATION
1	-	-	-	-		1		-	-	3200	Pol.
2	-	-	-	-		-		-	-	5000	Pol.
3	-	-	-	-		-		-	-	7000	Pol.
4	-	11	1	1		22		-	-	216	Pol.
5	14	34	16	27		25		-	-	126	Pol.
6	-	8	-	5		133		-	-	12,000	Pol.
7	-	1	-	12		48		-	-	6100	Pol.
8	-	18	-	4		94		-	2	5200	Pol.
9	-	25	5	11		94		2	-	17,300	Pol.
10	-	-	-	4		11		-	-	2100	Pol.
11	-	12	-	45		46		-	-	4100	Pol.
12	1	239	-	7		9		2	-	47	Bal.
13	-	335	-	67		2		-	-	91	Bal.

With the exception of Stations 12 and 13, which were located 1 and 5 miles offshore, respectively, all of the bottom samples were indicative of a biologically degraded environment. In addition to the organisms listed in Table 34, 9 sewage fly larvae were found at Station 4; at Station 9, 2 sewage fly larvae and 2 crayfish were among the organisms collected. The harbor bottom consisted primarily of sand, silt and detritus.

Fig. 4 Locations of lake bed (benthic) stations in the Great Lakes Naval Training Center Harbor and adjacent waters.



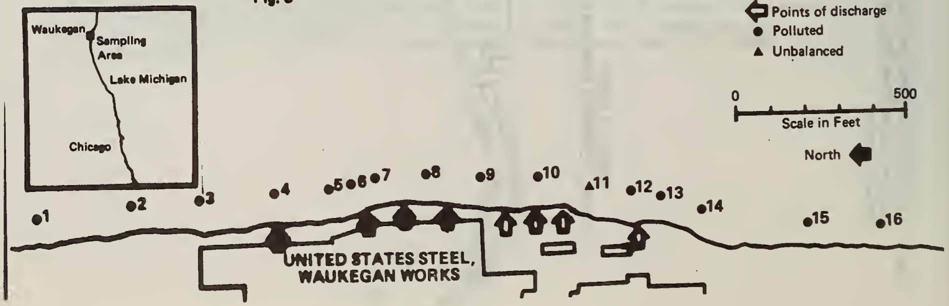
UNITED STATES STEEL PLANT, WAUKEGAN

TABLE 35. Bottom organisms collected during benthic sampling off the United States Steel Waukegan plant. Data are expressed as number of organisms per square foot.

STATION	CADDISFLY LARVAE	SCUDS	AQUATIC SOW BUGS	FINGERNAIL CLAMS	GILLED SNAILS	MIDGE LARVAE	FLATWORMS	PULMONATE SNAILS	LEECHES	AQUATIC WORMS	POLLUTION CLASSIFI-CATION
1		1		1		2				21	Pol.
2		1		-		-				-	Pol.
3		2		-		-				5	Pol.
4		4		-		1				1	Pol.
5		-		-		-				1	Pol.
6		10		-		-				-	Pol.
7		6		-		-				-	Pol.
8		4		-		-				-	Pol.
9		9		-		1				-	Pol.
10		4		-		-				-	Pol.
11		15		-		2				4	Unbal.
12		1		-		1				-	Pol.
13		6		-		-				19	Pol.
14		4		-		3				4	Pol.
15		2		1		12				28	Pol.
16		1		-		1				6	Pol.

All sixteen of the bottom samples collected off the U.S. Steel plant were indicative of a biologically degraded environment. Discharges of heavy metals probably account for the low number of organisms. A sediment sample collected near outfall 6 contained 594 ppm lead. The lake bottom in this area consists primarily of fine sand.

Fig. 5



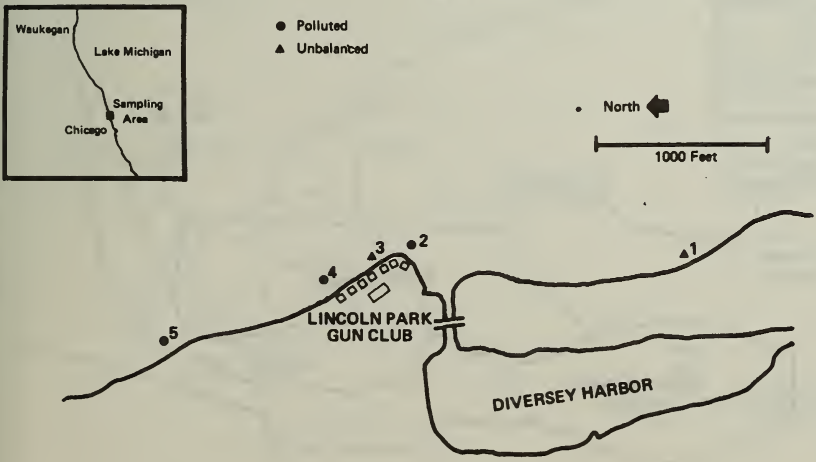
LINCOLN PARK GUN CLUB, CHICAGO

TABLE 36. Bottom organisms collected during benthic sampling off the Lincoln Park Gun Club. Data are expressed as numbers of organisms per square foot.

STATION	CADDISFLY LARVAE	SCUDS	AQUATIC SOW BUGS	FINGERNAIL CLAMS	GILLED SNAILS	MIDGE LARVAE	FLATWORMS	PULMONATE SNAILS	LEECHES	AQUATIC WORMS	POLLUTION CLASSIFI-CATION
1	-	5		18	2	4		-	-	21	Unbal.
2	-	18		377	25	30		2	2	183	Pol.
3	-	2		18	-	-		2	-	11	Unbal.
4	2	25		240	7	45		-	-	215	Pol.
5	-	28		94	5	8		-	2	103	Pol.

All five of the bottom samples collected off the Lincoln Park Gun Club were indicative of a biologically degraded environment. Lead pellets were found at Stations 2 through 5 in concentrations of 55, 2, 14 and 1 pellets, respectively. The lake bottom in this area consisted primarily of fine sand.

Fig. 6



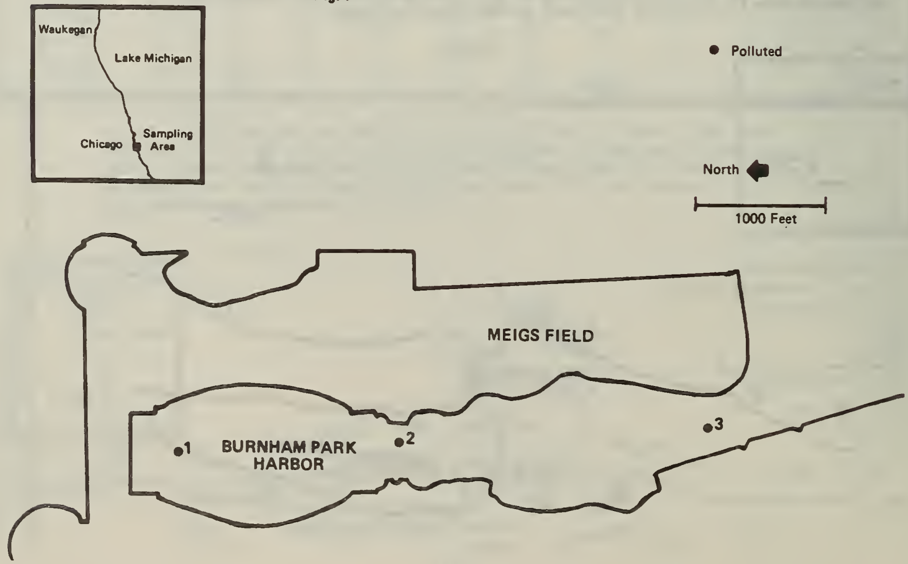
BURNHAM PARK HARBOR, CHICAGO

TABLE 37. Bottom organisms collected during benthic sampling in Burnham Park Harbor. Data are expressed as numbers of organisms per square foot.

STATION	CADDISFLY LARVAE	SCUDS	AQUATIC SOW BUGS	FINGERNAIL CLAMS	GILLED SNAILS	MIDGE LARVAE	FLATWORMS	PULMONATE SNAILS	LEECHES	AQUATIC WORMS	POLLUTION CLASSIFI-CATION
1	1	-	4	9		9		4	11	2100	Pol.
2	-	4	4	28		66		2	-	2200	Pol.
3	-	2	-	6		3		-	5	1000	Pol.

All three bottom samples collected within Burnham Park Harbor were indicative of a biologically degraded environment. The harbor bottom consisted primarily of silt, clay, sand and detritus.

Fig. 7



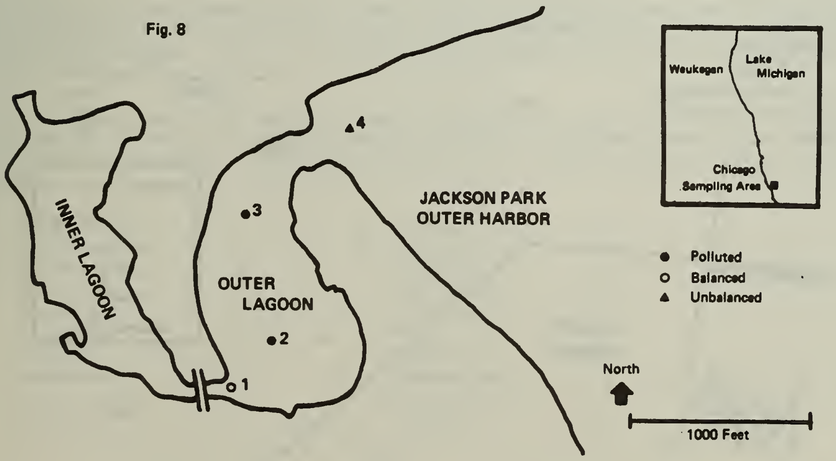
JACKSON PARK OUTER HARBOR, CHICAGO

TABLE 38. Bottom organisms collected during benthic sampling in Jackson Park Outer Harbor. Data are expressed as numbers of organisms per square foot.

STATION	CADDISFLY LARVAE	SCUDS	AQUATIC SOW BUGS	FINGERNAIL CLAMS	GILLED SNAILS	MIDGE LARVAE	FLATWORMS	PULMONATE SNAILS	LEECHES	AQUATIC WORMS	POLLUTION CLASSIFICATION
1		4	7	1	-	4	1	1	-	1	Bal.
2		-	2	36	-	294	2	-	-	5500	Pol.
3		2	-	91	-	107	-	-	4	840	Pol.
4		1	-	41	3	13	-	2	-	30	Unbal.

Three of the four bottom samples collected within Jackson Park harbor were indicative of a biologically degraded environment. The harbor bottom consisted primarily of silt, sand and detritus.

Fig. 8



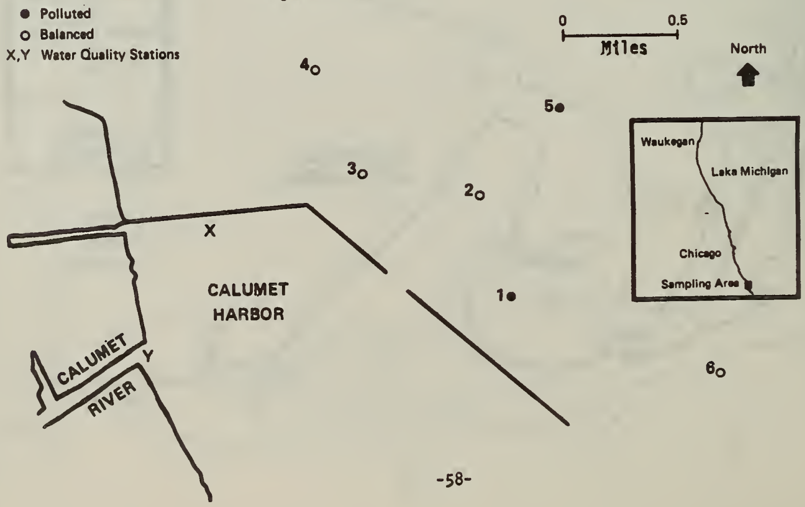
CALUMET HARBOR BREAKWATER, CHICAGO

TABLE 39. Bottom organisms collected during benthic sampling off the Calumet Harbor breakwater. Data are expressed as numbers of organisms per square foot.

STATION	CADDISFLY LARVAE	SCUDS	AQUATIC SOW BUGS	FINGERNAIL CLAMS	GILLED SNAILS	MIDGE LARVAE	FLATWORMS	PULMONATE SNAILS	LEECHES	AQUATIC WORMS	POLLUTION CLASSIFICATION
1		587		13	-	11			6	1100	Pol.
2		33		1	-	3			-	12	Bal.
3		289		45	3	18			-	121	Bal.
4		31		8	3	4			-	13	Bal.
5		64		134	15	39			4	107	Pol.
6		27		4	-	4			-	-	Bal.

Two of the six bottom samples collected off the Calumet Harbor breakwater were indicative of a biologically degraded environment. The lake bottom in this area consisted primarily of sand, clay and silt.

Fig. 9



PHYTOPLANKTON SAMPLING

GENERAL INFORMATION

Phytoplankton are the minute, mostly microscopic plant organisms which drift in the water subject to the action of waves and currents. Forming the base of aquatic food chains, they are a primary source of food for fish and other aquatic organisms.

Phytoplankton sampling is conducted primarily to determine eutrophication trends. Eutrophication, which is the natural aging process of a body of water, is accelerated by increased levels of nutrients. There is a causal relationship between nutrient levels and phytoplankton densities. Analyses of phytoplankton populations provide information on the phenomenon of eutrophication.

Phytoplankton, when present in high concentrations, cause taste and odor problems in public water supplies, shorten filter runs in water treatment facilities, lower lakefront property values, interfere with industrial water use, reduce levels of dissolved oxygen in water upon decay with possible deleterious effects on other aquatic life and may cause skin rashes in susceptible individuals.

RESULTS

During 1971, 127 phytoplankton samples were collected and identified to genus. Samples were collected at selected water treatment plant raw water supplies, public bathing beaches, and offshore of the Commonwealth Edison plant in Zion

Of the major groups the green algae (Chlorophyta) and the yellow-greens (Chrysophyta) were found in all samples. The blue-greens occurred in 36.2% of the samples followed by the cryptomonads (Cryptophyta) at 10.2%. The dinoflagellates (Pyrrhophyta), euglenoids (Euglenophyta) and the red algae (Rhodophyta) comprised 7.9, 3.1 and 0.8% of all samples respectively. Table 40 lists the genera found during the 1971 survey.

When total numbers are considered for all samples the most dominant groups were the yellow-greens 70.0%, followed by the greens 27.6%, blue-greens 1.1%, euglenoids 0.4%, cryptomonads 0.4% and the dinoflagellates 0.5%. The red algae were identified only once at the 100th Street beach in Chicago.

A pollution index developed by C. Mervin Palmer was used to evaluate the effect of organic pollution on phytoplankton by assigning a rating to each of 20 genera based on its significance as a pollution indicator. The algal genus pollution index reported by Palmer assigns the following rating:

Anacystis	1	Micractinium	1
Ankistrodesmus	2	Navicula	3
Chlamydomonas	4	Nitzchia	3
Chlorella	3	Oscillatoria	5
Closterium	1	Pandorina	1
Cyclotella	1	Phacus	2
Euglena	5	Phormidium	1
Gomphonema	1	Scenedesmus	4
Lepocinclis	1	Stigeoclonium	2
Melosira	1	Synedra	2

In applying this index a genera is not considered present unless a count of at least 50 or more per milliliter is obtained. An index rating of 20 or more indicates high organic pollution, 15-19 indicates possible evidence of high organic pollution, and values below 15 indicate the lack of organic pollution or other factors which may limit the production of these indicator genera.

An index equal to or in excess of 15 was recorded in only 4 of the 127 samples. These locations were Winthrop Harbor-Main Street Beach which had an index of 15 recorded on 7/12/71, Touhy Avenue Beach which had an index of 16 recorded on 7/12/71 and an index of 15 recorded on 10/18/71. Oak Street Beach recorded an index of 19 on 10/18/71. Annual averages at all locations did not exceed 9. It would be expected that the annual average would reflect an index in excess of 15 if there was a continuous high loading which was highly organic in nature. The pollution index did not pinpoint known sources of organic loading which may indicate the need for further sampling. A listing of Palmer scores for all sample locations is listed in Table 41.

TABLE 40. List of phytoplankton genera collected in the Illinois portion of Lake Michigan in 1971.

CHLOROPHYTA

Actinastrum
Ankistrodesmus
Carteria
Chlamydomonas
Chlorella
Chlorococcum
Chodatella (Lagerheimia)
Cladophora
Coelastrum
Cosmarium
Distyosphaerium
Gloeocystis
Kirchneriella
Micractinium
Microspora
Oedogonium
Oocystis
Palmella
Pandorina
Pediastrum
Phacus
Quadrigula
Scenedesmus
Selenastrum
Sphaerocystis
Staurastrum
Ulothrix
Ulotrichales
Unidentified Greens
Westella

CHRYSOPHYTA

Amphora
Asterionella
Cocconeis
Cyclotella
Cymbella
Diatoma
Dinobryon
Fragilaria
Melosira
Meridion
Navicula
Nitzschia
Pinnularia
Rhizosolenia
Rhoicosphenia
Stephanodiscus
Surirella
Synedra
Tabellaria

CYANOPHYTA

Anabaena
Anacystis (Microcystis)
Aphanothece
Agmenellum (Merismopedia)
Chroococcus
Coelosphaerium
Gomphosphaeria
Oscillatoria
Unidentified Blue - Greens

EUGLENOPHYTA

Euglena
Trachelomonas

PYRRHOPHYTA

Ceratium
Peridinium

CRYPTOPHYTA

Cryptomonas

RHODOPHYTA

Asterocystis

TABLE 41. Palmer pollution index scores for phytoplankton samples collected in the Illinois portion of Lake Michigan in 1971.

SAMPLE LOCATION	PALMER SCORES Range	PALMER SCORES Annual Average	Number of Samples
Winthrop Harbor-Main St. Beach	2-15	8	7
Lake Bluff-Center Avenue Beach	3-9	6	7
Highland Park-Park Avenue Beach	3-8	4	5
Wilmette-Lake Ave. Beach	3-6	5	5
Chicago-Touhy Ave. Beach	3-16	9	7
Chicago-Oak Street Beach	3-19	8	6
Chicago-100th Street Beach	3-14	9	7
North Chicago Water Plant	3-12	6	12
Highland Park Water Plant	0-14	8	10
Winnetka Water Plant	1-14	7	10
Wilmette Water Plant	3-14	7	10
Evanston Water Plant	3-10	6	10
Chicago Central Water Plant	2-12	7	11
Chicago South Water Plant	0-6	4	10
Zion-Commonwealth Edison	1-3	3	4
Zion Benton Water Plant	2-12	7	2
Glencoe Water Plant	--	6	1
Kenilworth Water Plant	--	5	1
Waukegan Water Plant	--	2	1
Lake Forest Water Plant	--	5	1

SPECIAL SAMPLING

GENERAL INFORMATION

Environmental investigations have revealed the existence of potentially harmful contaminants in the aquatic ecosystem. Chlorinated hydrocarbon pesticides, of which DDT is the most widely known example, fall into this classification. Heavy metals, including mercury, are another group of contaminants of environmental concern. Of more recent concern are several chemical compounds which have only recently been identified in the aquatic ecosystem and which have potentially significant environmental impact. These chemicals are polychlorinated biphenyls and phthalates.

PESTICIDES

On June 25, 1969, the Pesticide Control Law was passed in Illinois. The act provided for labeling of pesticides to prevent contamination of water and environment by regulating, restricting or prohibiting the sale, use or application of pesticides. The sale, use or application of DDT was prohibited in Illinois without a permit from the Director of the Department of Public Health, effective January 1, 1970.

Chlorinated hydrocarbon pesticides are undesirable in the environment because they may persist for months and years following application. In 1971, analyses were performed for Total DDT (p, p' - DDD) + (o, p' - DDD) + (p, p' - DDT) + (o, p' - DDT) + (p, p' - DDE) + (o, p' - DDE), Heptachlor epoxide, Dieldrin, Methoxychlor, Lindane, Heptachlor, Aldrin and Endrin.

POLYCHLORINATED BIPHENYLS

The polychlorinated biphenyls have recently been found in Lake Michigan water, sediment and fish. PCB's, which are extremely persistent chlorinated hydrocarbons, have been found to accumulate through food chains of fish and birds, and may have an effect on reproductive potential.

PCB's are used in the production of adhesives, asphalt, elastomers, electrical insulation, fire-resistant heat transfer and hydraulic fluids, special lubricants, sealants and expansion media, synthetic rubber, floor tile, printers ink, coatings for paper and fabrics, pigments, resin, paints, varnishes and waxes.

PHTHALATES

Phthalates are a second class of chemical compounds of recent environmental concern. They are used as plasticizers in the plastics industry, particularly in the production of polyvinyl chloride plastics.

Two phthalate esters, DOP (ethylhexyl phthalate) and DBP (n-dibutyl phthalate), have been encountered in the routine analysis of Lake Michigan water for DDT. Subsequent investigations have confirmed the presence of phthalates in fish, especially those taken from bodies of water associated with large urban and industrial areas.

HEAVY METALS

Water samples collected in 1971 were analyzed for the following heavy metals: Cadmium, Chromium (Hex), Chromium (Tri), Copper, Iron (Dissolved), Lead, Manganese, Nickel, Selenium and Zinc. This involved the analyses of 1,707 water samples. Twenty-eight sediment samples were analyzed for Lead, Mercury and Selenium. Analyses for Lead, Mercury and Selenium in fish involved four species of lake fish: yellow perch, chubs, carp and coho salmon. In all, 12 composite fish samples (56 fish) were examined.

RESULTS OF MONITORING

PESTICIDES, POLYCHLORINATED BIPHENYLS AND PHTHALATES

WATER SAMPLES

Water samples were collected at Pettibone Creek, the Waukegan River and the North Shore Sanitary District sewage treatment plants at North Chicago and Waukegan (Table 42). Lindane, Aldrin, Endrin, Heptachlor and DBP were not present at detectable levels.

The polychlorinated biphenyls and DOP were found in higher concentrations than any of the pesticides. PCB values ranged from 0.33 ppb (330 ppt) to 4.59 ppb (4,590 ppt) with an average value of 1.48 ppb (1,480 ppt). DOP concentrations ranged from not detectable to 0.76 ppb (760 ppt) with an average of 0.18 ppb (180 ppt). The highest PCB and DOP concentrations were found in effluent samples from the NSSD Waukegan sewage treatment plant.

There are no water quality standards for PCB's at present. The federal Interdepartmental Task Force on PCBs has proposed that PCB levels in rivers or lakes should not exceed 0.01 ppb. All values recorded in 1971 were considerably above the proposed level.

Pesticides were found in the parts per trillion range. Total DDT levels ranged from 4.58 to 37.73 ppt with an average of 20.30 ppt. Average values for Methoxychlor, Dieldrin and Heptachlor epoxide were 27.81, 25.75 and 4.09 ppt, respectively. There are no water quality standards for pesticides.

SEDIMENT SAMPLES

Thirty-seven sediment samples were collected for analyses at tributary streams, ravines, and offshore lake bed stations (Table 43). Aldrin and Endrin were not present at detectable levels.

Total DDT concentrations ranged from 0.43 to 201.19 ppb with an average of 29.01 ppb. Average values for Methoxychlor, Dieldrin and Heptachlor epoxide were 8.43, 0.80 and 0.65 ppb, respectively.

Except for three positive values for phthalate residues (DOP) recorded in lake sediments, Lindane, Heptachlor, DOP and DBP were not present at detectable levels in the lake sediments. Positive values for these four parameters were recorded only in sediments from the tributary streams and ravines; maximum values were 0.15, 0.25, 218.00 and 120.00 ppb, respectively.

FISH SAMPLES

The Technical Committee on Pesticides established by the Lake Michigan Enforcement Conference recommended that the concentrations of pesticides in fish should not exceed 1.0 parts per million DDT, 0.5 parts per million DDD, 0.1 parts per million dieldrin, and that all other chlorinated hydrocarbon pesticides, singly or combined, should not exceed 0.1 parts per million based on the wet weight of the tissue sampled.

Twenty-nine composite samples from five species of lake fish (yellow perch, chubs, carp, coho salmon and alewives) were analyzed for pesticides, PCB's and phthalates (Table 44).

The average DDT level found in fish was 1.4 ppm which exceeded the Technical Committee's recommendation of 1.0 ppm. The highest average DDT concentrationsby sex and species were 0.9 ppm for yellow perch males, 4.1 ppm for chub males, 1.2 ppm for carp males, 0.6 ppm for coho salmon females and 1.7 ppm for alewife males. The range of concentrations for all fish was from 0.3 to 4.2 ppm. While 14 of the composite samples exceeded the recommended DDT level, these levels were below the 5.0 ppm "action level" for DDT established by the U.S. Food and Drug Administration. Other than total DDT, only one other chlorinated hydrocarbon pesticide reached concentrations above 0.1 ppm. Dieldrin levels up to 0.5 ppm were recorded three times. Concentrations of Heptachlor epoxide, methoxychlor and Lindane were 0.1 ppm or less.

Polychlorinated biphenyls in the composite samples ranged from 0.1 to 4.0 ppm with an average concentration of 2.1 ppm. The highest average concentrations of PCB's by sex and species were 0.4 ppm for yellow perch males, 3.4 ppm for chub males, 2.3 ppm for both carp males and females, 2.2 ppm for coho salmon males and 3.1 ppm for alewife males. These concentrations were below the U.S. Food and Drug Administration's interim action level of 5 ppm.

DOP concentrations were found at measurable levels in yellow perch (0.2 - 0.4 ppm) and chubs (1.1 - 1.3 ppm) with trace amounts in carp. Measurable DBP levels were 0.1 ppm or less. Guideline concentrations for phthalates have not been developed.

HEAVY METALS

WATER SAMPLES

Water samples collected at the raw water intakes of municipal water filtration plants and at the 4-mile lake water quality stations were analyzed for Arsenic, Cadmium, Chromium (Hex), Chromium (Tri), Copper, Iron (Dissolved), Lead, Manganese, Nickel and Zinc (Table 45). Measurable readings were recorded for Copper, Iron (Dissolved), Manganese and Zinc. Maximum values for these four parameters were 0.06, 0.20, 0.05 and 0.13 mg/l, respectively. These values were within the limits of the U.S. Public Health Service's 1962 Drinking Water Standards.

An additional 15 samples were collected for Selenium analyses at 11 water filtration plants, 2 sewage treatment plants, 1 tributary stream and 1 industry (Table 46). The concentrations in these samples ranged from not detected to 1.80 ppb with an average of 0.47 ppb. These levels were within the U.S.P.H.S. standard of 0.01 mg/l (10 ppb).

SEDIMENT SAMPLES

Twenty-eight lake sediment samples were collected for Lead, Mercury and Selenium analyses (Table 47). Lead concentrations ranged from 11.0 to 594.0 ppm with an average of 54.6 ppm. Mercury levels ranged from less than 0.001 to 0.060 ppm with an average of 0.011 ppm. Selenium concentrations in the sediment samples ranged from less than 0.001 ppm to 0.085 ppm with an average of 0.007 ppm.

FISH SAMPLES

Twelve composite fish samples consisting of yellow perch, chubs, coho salmon and carp were analyzed for Lead, Mercury and Selenium (Table 48).

Lead concentrations ranged from 0.16 to 1.28 ppm with an average of 0.54 ppm. The highest average concentrations by sex and species were 0.26 ppm for yellow perch males, 0.67 ppm for chub males, 1.28 ppm for coho salmon females and 0.68 ppm for carp males.

Mercury concentrations ranged from less than 0.001 to 0.103 ppm with an average of 0.029 ppm. The highest average concentrations by sex and species were 0.090 ppm for yellow perch males, 0.016 ppm for both chub males and females, 0.017 ppm for coho salmon females and 0.016 ppm for carp females. The highest concentration found in the composite samples (0.103 ppm) was below the 0.5 ppm interim guideline limit established by the U.S. Food and Drug Administration.

Selenium concentrations ranged from 0.004 to 0.035 ppm with an average of 0.009 ppm. The highest average concentrations by sex and species were 0.007 ppm for yellow perch males, 0.007 ppm for chub females, 0.035 ppm for coho females add 0.010 ppm for carp males.

There are no standards for these heavy metals in fish flesh.

TABLE 42. Concentrations of some of the common hydrocarbon insecticides, polychlorinated biphenyls and phthalates found in the effluents of two sewage treatment plants and two streams tributary to Lake Michigan. Concentrations of all pesticides are in parts per trillion (ppt); concentrations of polychlorinated biphenyls and phthalates are indicated in parts per billion (ppb).

SAMPLE LOCATION	DATE COLLECTED	Total DDT(1) (ppt)	Total PCB(2) (ppb)	Heptachlor Epoxide (ppt)	Dieldrin (ppt)	Methoxychlor (ppt)	DOP(3) (ppb)
NSSD Waukegan STP	9/17/71	37.73	0.74	3.15	13.74	106.0	0.76
NSSD Waukegan STP	8/4/71	27.27	2.58	4.14	23.77	26.5	0.65
NSSD Waukegan STP	7/22/71	19.96	4.59	4.43	38.80	21.8	0.09
Waukegan River	8/18/71	23.72	2.20	5.42	22.50	5.9	0.08
Waukegan River	7/29/71	15.04	--	ND	14.50	2.9	ND
NSSD North Chicago STP	7/23/71	4.58	1.32	0.29	64.30	17.7	0.16
NSSD North Chicago STP	8/4/71	20.64	0.42	17.20	31.82	44.2	ND
NSSD North Chicago STP	8/25/71	14.97	0.75	3.30	43.50	ND	0.09
Pettibone Creek	8/26/71	18.72	0.38	1.43	2.50	22.4	ND
Pettibone Creek	7/29/71	20.39	0.33	1.57	2.05	30.7	ND

(1) Total DDT includes p, p' - DDD; o, p' - DDD; p, p' - DDT; o, p' - DDT; o, p' - DDE and p, p' - DDE.

(2) Total PCBs includes 1242 and 1254.

(3) DOP - ethylhexyl phthalate

Lindane, Aldrin, Endrin, Heptachlor and n-dibutyl phthalate were not detected in any of the ten samples.

ND - Not Detected

TABLE 43. Concentrations of some hydrocarbon insecticides, polychlorinated biphenyls, and phthalates found in Lake Michigan sediments and in tributary stream and ravine sediments. Values are indicated in parts per billion (ppb) on a dry weight basis.

SAMPLE LOCATION		TOTAL DDT	TOTAL PCB	HEPTACHLOR EPOXIDE
<1 to 3 MILES OFFSHORE				
NSSD Park Ave. STP (Highland Park)		4.93	23.53	0.02
NSSD Lake Forest STP (Lake Forest)		2.26	17.53	0.01
NSSD Lake Bluff STP (Lake Bluff)		3.00	58.81	0.01
NSSD North Chicago STP (North Chicago)		2.56	132.61	0.02
NSSD Waukegan STP (Waukegan)		1.38	29.29	ND
Lake Bed				
Station	60	16.09	13.09	0.06
"	55	10.76	6.72	0.07
"	52	7.02	11.81	0.02
"	49	10.02	26.07	0.15
"	46	25.20	87.98	0.11
"	43	26.46	130.27	0.08
"	40	9.85	26.61	0.17
"	37	10.19	64.32	0.12
"	34	4.00	3.72	0.01
"	31	3.55	3.87	0.01
"	28	6.77	35.80	0.01
"	24	5.03	8.31	0.01
"	21	3.16	15.24	ND
"	18	1.37	16.08	ND
"	15	1.64	12.68	0.01
"	12	1.35	36.70	0.02
"	8	1.91	41.06	0.02
"	5	2.24	80.63	0.02
"	2	1.03	13.34	0.02
~10 to 50 YARDS UPSTREAM FROM LAKE				
Bull Creek (Zion)		0.43	22.10	0.03
Dead River (Zion)		0.79	18.59	0.02
unnamed channel (Waukegan)		13.79	636.04	0.07
Waukegan River (Waukegan)		10.17	505.00	3.75
Pettibone Creek (North Chicago)		134.96	405.40	2.08
Stone Gate Lane Ravine (Lake Forest)		79.35	11.22	2.04
Ferry Hall School Ravine (Lake Forest)		52.98	18.68	3.50
Cary Avenue Ravine (Highland Park)		123.41	20.90	3.81
Ravine Drive Ravine (Highland Park)		84.70	6.38	2.83
Park Ave. Ravine (Highland Park)		201.19	5.86	3.27
Barat Ravine (Lake Forest)		5.30	7.28	0.15
Ravine Park Ravine (Lake Bluff)		40.47	3.85	1.64
Kellogg Creek (Zion)		1.48	4.33	0.03

TABLE 43. (Continued)

DIELDRIN	METHOXYCHLOR	LINDANE	HEPTACHLOR	DOP	DBP
0.14	0.31	ND	ND	4.13	ND
0.11	0.55	ND	ND	ND	ND
0.06	0.91	ND	ND	ND	ND
0.13	0.80	ND	ND	ND	ND
0.03	0.30	ND	ND	7.18	ND
0.29	0.70	ND	ND	ND	ND
0.48	1.11	ND	ND	ND	ND
0.19	0.87	ND	ND	ND	ND
0.67	1.94	ND	ND	ND	ND
0.52	1.73	ND	ND	ND	ND
1.25	2.18	ND	ND	ND	ND
1.22	1.15	ND	ND	ND	ND
0.86	6.60	ND	ND	ND	ND
0.09	0.71	ND	ND	ND	ND
0.05	0.71	ND	ND	ND	ND
0.23	0.92	ND	ND	ND	ND
0.14	4.68	ND	ND	ND	ND
0.04	0.68	ND	ND	ND	ND
0.03	0.67	ND	ND	ND	ND
0.04	0.60	ND	ND	ND	ND
0.07	0.52	ND	ND	ND	ND
0.11	0.59	ND	ND	ND	ND
0.23	0.13	ND	ND	ND	ND
0.05	0.41	ND	ND	1.05	ND
0.08	0.50	ND	0.06	ND	ND
0.17	0.44	ND	0.05	ND	ND
1.04	9.40	ND	ND	218.00	ND
0.44	2.98	ND	0.24	ND	ND
0.57	2.44	ND	0.01	51.30	ND
0.43	11.80	ND	0.05	42.90	ND
0.95	41.00	0.01	0.08	ND	ND
1.60	13.10	0.01	0.07	ND	ND
2.54	9.10	ND	0.09	28.50	25.00
9.50	6.90	0.03	0.12	57.00	120.00
1.04	175.00	ND	0.01	ND	ND
4.25	1.80	0.15	0.03	ND	ND
0.01	0.19	ND	ND	ND	ND

DOP = ethylhexyl phthalate
DBP = n-dibutyl phthalate
ND = not detected; Aldrin and Endrin not detected in any samples

TABLE 44. Concentrations of some of the common hydrocarbon insecticides, polychlorinated biphenyls, and phthalates found in the edible portions of five species of Lake Michigan fish. Values are expressed in parts per million on a wet weight basis.

SPECIES	NUMBER AND SEX ANALYZED	SIZE IN INCHES	SAMPLE LOCATION	DATE COLLECTED
Yellow Perch	4 Male	7.0 - 10.5	Chicago	10-6-71
Yellow Perch	5 Male	8.0 - 11.0	Chicago	10-6-71
Yellow Perch	5 Female	8.0 - 12.0	Chicago	10-6-71
Yellow Perch	5 Female	8.0 - 10.0	Chicago	10-6-71
Chub	5 Female	9.0 - 10.0	Waukegan	7-13-71
Chub	5 Female	10.0 - 10.5	Waukegan	7-13-71
Chub	5 Male	9.5 - 12.0	Waukegan	7-13-71
Chub	5 Male	10.0 - 12.0	Waukegan	7-13-71
Carp	5 Male	17.5 - 27.5	Chicago	4/13 - 4/20/71
Carp	4 Male	17.0 - 23.5	Chicago	4-20-71
Carp	4 Female	18.0 - 25.0	Chicago	4/13 - 4/20/71
Carp	5 Female	22.5 - 25.5	North Chicago	5-25-71
Carp	5 Female	23.5 - 30.0	North Chicago	5-25-71
Carp	5 Male	18.0 - 23.0	Chicago	4/13 - 4/20/71
Coho Salmon	5 Male	18.5 - 21.5	Chicago	4/13 - 4/20/71
Coho Salmon	4 Male	18.0 - 20.0	Chicago	4/13 - 4/20/71
Coho Salmon	5 Female	18.5 - 21.0	Chicago	4/13 - 4/20/71
Coho Salmon	5 Female	18.5 - 22.0	Waukegan	5-26-71
Coho Salmon	5 Male	20.0 - 23.5	North Chicago	5-26-71
Coho Salmon	5 Female	19.5 - 22.5	Waukegan	5-26-71
Coho Salmon	4 Male	18.5 - 21.5	North Chicago	4/13 - 5/26/71
Alewife	5 Male	6.0 - 7.0	Chicago	5-11-71
Alewife	5 Male	6.0 - 7.0	Chicago	5-11-71
Alewife	5 Female	6.0 - 7.0	Chicago	5-11-71
Alewife	5 Female	6.0 - 7.0	Chicago	5-11-71
Alewife	5 Female	6.0 - 7.0	North Chicago	4-28-71
Alewife	5 Female	6.0 - 7.0	North Chicago	4-28-71
Alewife	5 Male	6.0 - 7.0	North Chicago	4-28-71
Alewife	5 Male	6.0 - 7.0	North Chicago	4-28-71

TABLE 44. (Continued)

OTAL DDT	TOTAL PCB	HEPTACHLOR EPOXIDE	DIELDRIN	METHOXYCHLOR	LINDANE	DOP	DBP
1.2	0.4	<0.1	<0.1	ND	ND	0.3	<0.1
0.6	0.3	<0.1	<0.1	ND	ND	0.3	<0.1
0.3	0.1	<0.1	<0.1	ND	<0.1	0.2	<0.1
0.3	0.1	<0.1	<0.1	ND	ND	0.4	<0.1
3.5	2.8	<0.1	0.1	ND	<0.1	1.3	0.1
2.9	2.1	<0.1	0.1	ND	<0.1	1.1	0.1
4.2	3.5	<0.1	0.2	ND	<0.1	1.2	0.1
4.0	3.3	<0.1	0.2	ND	<0.1	1.3	0.1
1.0	2.3	<0.1	0.1	0.1	ND	ND	0.1
0.7	2.7	<0.1	<0.1	<0.1	ND	Trace	<0.1
0.9	3.2	<0.1	0.1	<0.1	ND	ND	<0.1
1.0	1.7*	<0.1	<0.1	ND	ND	ND	ND
1.3	1.9*	Trace	<0.1	ND	ND	ND	ND
2.0	1.9*	<0.1	0.1	ND	ND	ND	ND
0.6	1.9	<0.1	<0.1	ND	ND	ND	<0.1
0.4	1.7	<0.1	<0.1	0.1	ND	ND	0.1
0.5	1.4	<0.1	0.5	ND	ND	ND	<0.1
0.5	0.8*	<0.1	0.1	ND	ND	ND	ND
0.5	1.1*	<0.1	0.1	ND	ND	ND	ND
0.6	1.3*	<0.1	0.1	ND	ND	ND	ND
0.7	4.0	<0.1	0.1	ND	ND	ND	<0.1
1.8	3.0*	<0.1	0.1	ND	<0.1	ND	ND
1.9	3.3*	<0.1	0.1	ND	<0.1	ND	ND
1.3	2.5*	<0.1	0.1	ND	Trace	ND	ND
0.8	2.4*	<0.1	0.1	ND	<0.1	ND	ND
1.4	2.8*	<0.1	0.1	ND	<0.1	ND	ND
1.7	2.8*	<0.1	0.1	ND	<0.1	ND	ND
1.6	2.7*	<0.1	0.1	ND	ND	ND	ND
1.5	3.2*	<0.1	0.1	ND	ND	ND	ND

* Total PCB based on 1254 only; all other samples based on 1242 and 1254.

DOP = ethylhexyl phthalate

DBP = n-dibutyl phthalate

ND = not detected; Aldrin, Endrin and Heptachlor were not detected in any of the samples.

TABLE 45. Concentrations of heavy metals in Lake Michigan Open Water. Values are expressed in milligrams per liter (mg/l).*

HEAVY METALS	U.S. PUBLIC HEALTH SERVICE STANDARD	WATER FILTRATION PLANTS		4-MILE WATER QUALITY STATIONS	
		No. Samples	Maximum Value	No. Samples	Maximum Value
Arsenic	0.05	133	0.00	27	0.00
Cadmium	0.01	135	0.00	27	0.00
Chromium (Hex)	0.05	135	0.00	27	0.00
Chromium (Tri)	----	135	0.00	27	0.00
Copper	1.00	133	0.06	27	0.02
Iron (Dissolved)	0.30+	236	0.20	31	0.04
Lead	0.05	135	0.00	27	0.00
Manganese	0.05	129	0.01	16	0.05
Nickel	----	124	0.00	27	0.00
Zinc	5.00	134	0.13	27	0.03

* Water samples were collected at the municipal water filtration plants and at the 4-mile water quality stations.

+ SWB-7 Standard (Single daily value)

TABLE 46. Selenium concentrations found at selected water treatment plants, sewage treatment plants, one tributary stream and one industry. Values are indicated in parts per billion (ppb). All samples were collected January 13, 1972. *

	SAMPLE LOCATION	SELENIUM (ppb)
1.	Zion-Benton Water Plant	0.70
2.	NSSD Waukegan STP	0.80
3.	Waukegan Water Plant	0.60
4.	Abbott Laboratories	0.80
5.	NSSD North Chicago STP	0.20
6.	North Chicago Water Plant	1.80
7.	Pettibone Creek/GLNTC Harbor	0.30
8.	Lake Forest Water Plant	0.30
9.	Highland Park Water Plant	0.50
10.	Glencoe Water Plant	0.07
1.	Winnetka Water Plant	0.07
2.	Wilmette Water Plant	0.30
3.	Evanston Water Plant	ND
4.	Chicago Central Water Plant	0.50
5.	Chicago South Water Plant	0.07

* Samples from the 11 water plants are raw lake samples. Those from Abbott Laboratories and the North Shore Sanitary District (NSSD) sewage treatment plants are effluent samples.

TABLE 47. Concentrations of lead, mercury and selenium found in Lake Michigan sediments. Values are indicated in parts per million (ppm).

SAMPLE LOCATION		LEAD	MERCURY	SELENIUM
Lake Bed Station	2	20.0	0.002	0.004
"	5	21.0	0.004	0.010
"	8	28.0	0.003	0.005
"	12	33.0	0.008	0.002
"	15	25.0	0.005	0.004
"	18	13.0	0.007	0.005
"	21	38.0	0.013	0.003
"	24	28.0	0.002	0.005
"	28	37.0	0.001	0.001
"	31	23.0	0.056	0.011
"	34	13.0	0.017	0.001
"	37	15.0	0.006	0.002
"	40	11.0	< 0.001	0.002
"	43	12.0	< 0.001	0.003
"	46	55.0	0.020	0.005
"	49	59.0	-----	< 0.001
"	52	18.0	0.010	< 0.001
"	55	24.0	< 0.001	0.002
"	60	19.0	0.004	0.004
Lincoln Park Gun Club (50 ft. offshore at northern boundary)		24.0	0.011	0.004
Lincoln Park Gun Club (50 ft. offshore at southern boundary)		45.0	0.008	< 0.001
Lincoln Park Gun Club (50 ft. offshore at the mid property)		58.0	0.007	0.004
Calumet Harbor (50 ft. offshore and 50 ft. north of breakwall)		130.0	0.030	0.085
Calumet Harbor (50 ft. offshore at mouth of breakwall)		82.0	< 0.001	0.004
Belmont Harbor (50 ft. due east of entrance)		26.0	0.003	0.009
Indiana Comm. Edison (½ mile due east)		44.0	0.007	0.002
U.S. Steel - South (800 ft. east of North slip)		38.0	0.012	0.005
U.S. Steel - Waukegan Works (60 ft. east of outfall 6)		594.0	0.060	0.001
RANGE		(11.0-594.0)	(<0.001-0.060)	(<0.001-0.085)

TABLE 48. Concentrations of lead, mercury, and selenium found in edible portions of four species of Lake Michigan fish. Values are expressed as parts per million (ppm) on a wet weight basis.

SPECIES	NUMBER AND SEX OF FISH IN SAMPLE	SIZE RANGE IN INCHES	SAMPLE LOCATION	DATE OF COLLECTION	LEAD	MERCURY	SELENIUM
					(Parts Per Million)		
Yellow Perch	4 Male	7.0 - 10.5	Chicago	10-6-71	0.16	0.077	0.007
Yellow Perch	5 Male	8.0 - 11.0	Chicago	10-6-71	0.36	0.103	0.007
Yellow Perch	5 Female	8.0 - 12.0	Chicago	10-6-71	0.24	0.035	0.006
Yellow Perch	5 Female	8.0 - 10.0	Chicago	10-6-71	0.23	0.026	0.006
Chub	5 Female	9.0 - 10.0	Waukegan	7-13-71	0.67	0.016	0.006
Chub	5 Female	10.0 - 10.5	Waukegan	7-13-71	0.60	0.015	0.007
Chub	5 Male	9.5 - 12.0	Waukegan	7-13-71	0.57	0.027	0.006
Chub	5 Male	10.0 - 12.0	Waukegan	7-13-71	0.76	0.005	0.006
Coho Salmon	4 Male	17.0 - 23.5	Chicago	4-13/20-71	0.61	<0.001	0.007
Coho Salmon	5 Female	18.5 - 21.0	Chicago	4-13/20-71	1.28	0.017	0.035
Carp	4 Female	18.0 - 25.0	Chicago	4-13/20-71	0.32	0.016	0.004
Carp	4 Male	17.0 - 23.5	Chicago	4-20-71	0.68	0.015	0.010

LAKE MICHIGAN

ENFORCEMENT CONFERENCES

In March 1965, the Lake Michigan - Calumet Area Enforcement Conference established a deadline of December 31, 1968 for construction of necessary pollution control facilities for municipalities and industries in the Calumet area. Subsequent sessions of this conference extended the deadlines for some of the Indiana industries to 1972.

In January 1968, the Secretary of the Interior, at the request of the governor of Illinois, called the Lake Michigan - Four State Federal Enforcement Conference. Representatives from Illinois, Indiana, Michigan and Wisconsin established a schedule for the construction of municipal and industrial pollution control facilities in the entire Lake Michigan Basin. This conference instituted programs for:

a) Control of watercraft toilet wastes.

b) Phosphate reduction in sewage plant effluents.

c) Control of combined sewer overflows.

d) Prohibiting dumping of pollutional material into the lake.

e) Disinfection of sewage plant effluents.

f) Monitoring of Lake Michigan water quality.

Sessions in March, May and September of 1970 received progress reports on the original recommendations. Special consideration was given to the problems of thermal pollution, phosphates, total dissolved solids, pesticides and chlorides.

Sessions in 1971 were held on March 23-25 in Chicago; recommendations were made for:

a) Waste heat discharge regulations.

b) Pesticides monitoring.

c) Status of compliance of industries and municipalities.

d) Chlorides.

e) Phosphates.

LEGISLATIVE AND

REGULATORY ACTION

The following material provides a brief, chronological history of the activities of Illinois which have some bearing on the quality of Lake Michigan water.

GENERAL STANDARDS

In September 1966, the Illinois Sanitary Water Board adopted water quality standards (SWB-7) which included standards for Lake Michigan open water. These standards, along with implementation plans and compliance schedules, were approved by the U.S. Department of the Interior in January 1968. The Illinois Pollution Control Board amended the standards in 1971.

PHOSPHORUS STANDARDS

The phosphorus regulation, adopted January 6, 1971, tightened the water quality standard to 0.02 mg/l as phosphate. This is half the former requirement for individual samples and two-thirds of the SWB-7 requirement for annual average. An effluent standard of 3.0 mg/l as PO_4 was also adopted, but does not apply until 1972.

MERCURY STANDARDS

Mercury has only recently been recognized as an environmental hazard. Since no previous standard existed, new regulations were adopted March 31, 1971. The standard of 0.0005 mg/l, which applies to effluents as well as water quality, is apparently the same as the background concentration in Lake Michigan and is one tenth of the U.S. Public Health Service tentative standard for treated drinking water.

THERMAL STANDARDS

After extensive hearings beginning in 1970, the Illinois Pollution Control Board, on June 9, 1971, adopted thermal standards for Lake Michigan. These regulations are summarized in the following material. The requirements vary depending on whether the source of heated effluent was in operation, under construction, or in planning as of January 1, 1971.

Sources of heated effluents in operation as of January 1, 1971, must meet the following requirements outside of a mixing zone no larger than the area of a circle of 1000 foot radius (approximately 72 acres). The mixing zone does not have to be circular, nor does the point of discharge have to be in its center.

> Abnormal temperature changes which might affect aquatic life or alter normal daily and seasonal temperature fluctuations existing before the addition of heat will not be allowed. The water temperature must not rise more than 3°F above natural conditions and the following monthly maximums must not be exceeded.

January, February, March	45°F
April	55°F
May	60°F
June	70°F
July, August, September	80°F
October	65°F
November	60°F
December	50°F

> The owner or operator of a source of heated discharge must maintain any records and conduct any studies that the Environmental Protection Agency may require. During the one year period following June 9, 1976, the owner or operator of any source discharging 0.5 billion BTU/hr. or more must appear before the Pollution Control Board to demonstrate that the heated water discharge has not caused, nor can reasonably be expected to cause, significant ecological damage to Lake Michigan. If, at that time, such proof is not made to the satisfaction of the Board, or, if prior to or after that time any source is shown to be

> causing significant ecological damage, backfitting with alternative cooling devices will be required.

Sources of heated effluents under construction as of January 1, 1971, but not in operation must meet the following restrictions in addition to the above mentioned requirements for existing sources:

> The effluent temperature must not exceed ambient temperature by more than 20°F and the discharge structure must be so designed as to rapidly disperse the effluent, reducing the area of significant temperature rise. The heated effluent must not affect spawning grounds, fish migration routes, the shore, the bottom, or the cold lower strata of the lake. The effluents from more than one source must not be so close that their areas of thermal influence overlap. To provide reasonable protection to aquatic organisms, the cooling water intake must be so constructed as to reduce the number of organisms drawn into or against the structure. Condensers should be cleaned mechanically, or if chemicals are required to supplement the mechanical cleaners, their concentration at the point of discharge must not exceed the limits shown to be toxic (96 hour median tolerance limit[1]) for fresh water organisms.

No source of heated effluent which was not in operation or under construction as of January 1, 1971 shall discharge more than a daily average of 0.1 billion BTU/hr.

DDT

In June 1969, the 76th General Assembly approved an act prohibiting the sale and use of DDT in Illinois, except when the Illinois Department of Public Health allows its use in quelling an immediate threat to public health. The law became effective in January 1970, and the Department of Agriculture is the regulatory agency.

DUMPING

In October 1967, Senate Bill 1794 prohibited further deposition of any material in Lake Michigan except with the joint permission of the state pollution control agency (EPA) and the Illinois Department of Transportation. To date, the only permits issued involve non-pollutional material, such as steel pilings, concrete structures or clean sand.

ENFORCEMENT

In July 1970, the Environmental Protection Act came into effect. A Pollution Control Board of five members was appointed as a judicial body in pollution control activities. To regulate and enforce the act, an Environmental Protection Agency was formed. This agency assumed all of the pollution control responsibilities formerly delegated to the Illinois Department of Public Health. The Institute for Environmental Quality, which promotes research activities, was also established.

---

[1] This is a toxicity test for any substance in water and is the concentration at which exactly half of the organisms exposed for 96 hours survive.

FILTER BACKWASH

In October 1969, the Illinois Sanitary Water Board officially recognized filter backwash from water filtration plants as a pollutant. Illinois municipalities and the federal military installations operating water filtration plants on Lake Michigan are expected to meet effluent standards by December 31, 1973 (Water Pollution Regulations of Illinois, Chapter 3).

WATERCRAFT WASTE

On January 1, 1970, the State of Illinois Sanitary Water Board Rules and Regulations, SWB-19, prohibiting discharge of marine toilet wastes, became effective. Although the rule allows for the use of treatment systems, none of the present systems for treating watercraft wastes have demonstrated the required degree of treatment. At present retaining-type or incinerating toilets with residue discharge at approved on-shore facilities are the only approved systems.

The City of Chicago has a local ordinance which makes unlawful the discharge of marine toilet wastes in Chicago Harbors and inshore waters. This ordinance is effectively enforced by the Chicago Park District, which denies mooring permits to vessels that are not in compliance. Non-retaining type toilet systems must be officially sealed to make them inoperative while in Chicago Harbors. The Chicago Park District provides free pump-out stations for servicing the retaining-type toilet systems. These stations are located at Montrose, Belmont, Diversey, Burnham, 59th Street and Jackson Park Harbors. Since most of the boats that use the Illinois portion of Lake Michigan are moored in Chicago Harbors, the ordinance is effective in abating shore water pollution by watercraft wastes.

FINANCING

In November 1970, Illinois voters approved the issuance of $750,000,000 in bonds to assist municipalities and sanitary districts in financing construction, expansion and improvement of sewage treatment facilities. Half of the funds thus provided were to be made available to the Metropolitan Sanitary District of Greater Chicago (MSDGC). The remainder was to be distributed among all the other municipalities and sanitary districts.

A state grant may provide up to 25% of the total project cost. The combination of state and federal grant programs makesit possible for a municipality to receive assistance amounting to as much as 80% of the project cost. By the end of 1971 the statewide total of 105 grant offers amounted to $58,745,681.

During 1971, the North Shore Sanitary District received $8,641,985 in grant offers from the state. This amounts to 31% of the state funds offered to municipalities outside of the MSDGC. The North Shore Sanitary District received a federal grant offer of $11,550,000 in 1970.

Although the MSDGC improvement projects do not relate directly to Lake Michigan, programs to eliminate the conditions which result in the occasional discharge of contaminated river water to the lake are under consideration. During 1971, the MSDGC received $30,623,846 in state and $19,319,200 in federal grant offers.

SEWAGE TREATMENT PLANTS

DISCHARGING TO LAKE MICHIGAN

NORTH SHORE SANITARY DISTRICT

There are only seven Illinois municipal sewage treatment plants tributary to Lake Michigan. They are all operated by the North Shore Sanitary District and are located in Waukegan, North Chicago, Lake Bluff, Lake Forest and Highland Park (3 plants). The Waukegan and North Chicago plants provide secondary (biological) treatment. The others are primary (sedimentation) sewage treatment plants. All provide disinfection (chlorination) of their effluent. Except for the Highland Park plant at Ravine Drive all the plants are operating at or in excess of their design capacities. Therefore, particularly during periods of rain or thaw, inadequately treated waste is discharged to Lake Michigan. During the summer months, the excess flows are chlorinated, since all of these plants are in close proximity to public bathing areas.

The North Shore Sanitary District is now engaged in an extensive construction program, which, when completed, will divert all sewage effluent from the Lake Michigan watershed. The program provides for the diversion of the effluents from the Lake Bluff, Lake Forest and Highland Park plants to the District's Clavey Road sewage treatment plant (DesPlaines River watershed). The North Chicago sewage treatment plant effluent will be diverted to a new facility to be located in Gurnee (DesPlaines River watershed). Supplementary treatment and phosphate reduction facilities will be provided at the Waukegan sewage treatment plant. The effluent from the Waukegan plant will then be pumped for discharge to the DesPlaines River.

In 1968, the District's voters passed a referendum providing $35 million for the initial phase of the expansion projects. The last of these bonds was reportedly issued in May 1971. Construction at the Clavey Road sewage treatment plant was begun during 1969, but litigation instituted by a group of Highland Park residents has resulted in delays of the project schedule. After six days of public hearings, the Illinois Pollution Control Board ordered the District, on March 31, 1971, to complete immediately and expeditiously its proposed expansion facilities. This order authorized the District to issue any additional bonds required to complete the program without the passage of a public referendum and imposed a ban on connections to sanitary sewers within the North Shore Sanitary District.

On June 23, the Pollution Control Board accepted the NSSD timetable for project completion and ordered, as an interim measure, the use of certain chemicals to reduce BOD, suspended solids and phosphorus. The Waukegan sewage treatment plant began chemical feed in September 1971, because the necessary equipment was already installed. The other plants required additional construction and are under order to provide the chemical feed by January 1, 1973.

The project completion schedule accepted by the Pollution Control Board shows completion dates extending into late 1974. Total costs, including the numerous interim measures, are expected to substantially exceed the projected 95.27 million dollars.

MILITARY INSTALLATIONS

There are three military installations having sewage treatment facilities tributary to Lake Michigan. One plant has been abandoned and the other two are operating at less than their design capacity. The remaining plants provided the degree of treatment required during 1971 and disinfection of the effluent is subject to strict military medical corps monitoring.

Camp Logan, a state facility, abandoned the use of the sewage plant when regular occupation of the camp was halted. Currently, the rifle range is the only actively used portion of the camp. A small custodial crew occupied the camp buildings during 1971, but were served by a septic tank disposal system. Upon completion of the appropriate sewers and treatment plant improvements, Camp Logan's wastes will be directed to the North Shore Sanitary District's Waukegan Plant.

The Great Lakes Naval Training Center operates a trickling filter sewage treatment plant. Negotiations have been completed for the North Shore Sanitary District to accept these wastes when the new facility at Gurnee is in operation.

Fort Sheridan operates a trickling filter sewage treatment plant which is operating at roughly one quarter of its design capacity. Recent uncertainty over the future use of this installation has resulted in indefinite plans to connect to the North Shore Sanitary District's Clavey Road Plant upon completion of its expansion project.

ILLINOIS INDUSTRIES

DISCHARGING TO LAKE MICHIGAN

ABBOTT LABORATORIES (Manufacturers of drugs, antibiotics and pharmaceuticals). Abbott operates a waste treatment plant which provides secondary (biological) treatment of their extremely strong industrial waste. Recent water pollution control improvements have been completed and, in an effort to reduce the impact at the point of discharge, the effluent is mixed with spent process, cooling and storm water. The resultant discharge is generally within the state guidelines for effluent quality.

Current plans are to discharge Abbott's effluent to the North Shore Sanitary District once the Gurnee facility is operational.

COMMONWEALTH EDISON COMPANY, WAUKEGAN STATION (Fossil fuel electric generating station). This plant has been operating since 1927. At full capacity, the maximum temperature rise through the condensers is 12°F. Extensive studies of the thermal plume on the localized portion of the lake have identified no adverse effects.

COMMONWEALTH EDISON COMPANY, ZION STATION (Nuclear fuel electric generating station). Construction of this facility is nearing completion. Unit 1 is expected to be completed by March 1972, and Unit 2 by December 1972. At full capacity, the maximum temperature rise through the condensers is not expected to exceed 20°F. The Illinois Pollution Control Board has ruled that technical testimony does not substantiate the claim of possible thermal pollution. They have authorized the facility to utilize Lake Michigan for cooling providing all the requirements listed in their newly adopted thermal regulations are met.

FANSTEEL INCORPORATED, METALS DIVISION (Producers of corrosion-resistant metals used in electrical contacts, rectifiers, capacitors and chemical plants). Fansteel discharges industrial wastes to Pettibone Creek roughly one mile upstream of its confluence with Lake Michigan. Historically, the effluent has exceeded the state's guidelines for certain toxic chemicals. A proposal involving pre-treatment with eventual discharge to the North Shore Sanitary District treatment facility is under consideration.

JOHNSON MOTORS, DIVISION OF OUTBOARD MARINE CORPORATION (Manufacturers of outboard motors). The effluent from oil separating equipment is discharged to Waukegan harbor and through a ditch to Lake Michigan, several hundred yards north of Waukegan's North Beach. Metals concentrations are generally within the state guidelines. Occasional oil discharges seldom passes the barriers and baffles which cross the effluent ditch.

UNITED STATES STEEL CORPORATION, WAUKEGAN WORKS (Producers of stainless and carbon steel wire and springs). In-plant improvements and acid waste hauling for deep well disposal in Gary, Indiana, have resulted in major reduction of acid and metals discharged from this facility. The present discharge, via several outfalls, occasionally exceeds the state's effluent guidelines.

UNITED STATES STEEL CORPORATION, SOUTH WORKS (Steel smelting plant). This plant presently has outfalls discharging to Lake Michigan and the Calumet River. A court order issued January 18, 1971 requires a closed cycle system by 1975.

METROPOLITAN SANITARY DISTRICT

OF GREATER CHICAGO

All of the lake shore municipalities in Cook County (Glencoe through Chicago) are served by the Metropolitan Sanitary District of Greater Chicago. Except for several surface drains, no sewers within the jurisdiction of the District discharge directly to Lake Michigan. The District's three major sewage treatment plants and combined sewers (sewage and storm water) discharge to a system of waterways which are tributary to the DesPlaines River. Lock and dam facilities prevent back-flow of contaminated river water into Lake Michigan. Heavy rains may cause such heavy discharge to these waterways that the water level rises above the level of the lake resulting in back-flow through the locks and overflow of the dams. Therefore, the District maintains an alert system with the Lockport control facilities. Whenever heavy rain is predicted, the Lockport Dam lowers the water level in the rivers and thereby prevents or minimizes the discharge from the MSDGC waterways to Lake Michigan. The last such discharge occurred on August 16, 1968.

UNIVERSITY OF ILLINOIS-URBANA
3 0112 084227914